

Application Profile

Application Number: R305MA5060

Competition: 84.305MA5

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Organization Information

Organization Name: EDUCATION DEVELOPMENT CENTER, INC.

Organization Unit: Center for Children and Families

Organization Address: 55 Chapel Street

Newton, MA 02458-1060

Country: United States of America

Project Director Name and Information

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Collaboration Organization(s)

Organization Name	Organization Type	State	Country	Key Personnel	Role on Project
Action for Boston Community Development	Non-Profit Organization	MA	United States of America	Scott-Chandler, Sharon	
Communities United Inc.	Non-Profit Organization	MA	United States of America	Dimino, Stacy	
South Middlesex Opportunity Council	Non-Profit Organization	MA	United States of America	Fokas, Philip	
Montachusetts Opportunity Council	Non-Profit Organization	MA	United States of America	Hubbard, Deborah	
Self Help Inc. Head Start/Preschool	Non-Profit Organization	MA	United States of America	Foley, Patricia	
University of Massachusetts Amherst	Public College or University	MA	United States of America	Honan, Linda	

Application Title

Assessing the Potential Impact of a Professional Development Program in Science on Head Start Teachers and Children

Period of Performance

Project Begin Date: 07/01/2005

Project End Date: 06/30/2008

Abstract

ABSTRACT

Education Development Center, Inc. (EDC) is pleased to resubmit its proposal to conduct a Teacher Quality Goal 2 project, Assessing the Potential Impact of a Professional Development Program in Science on Head Start Teachers and Children. We thoroughly reviewed panelists' comments on our prior submission and have refined the structure of the professional development; added the development of new measures; and

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supplemented our team with a cognitive scientist as well as expert advisors. These and other changes have significantly strengthened this application, previously rated as "very good." Over 3 years, we will design, pilot test, refine, and retest a credit-bearing program, Foundations of Science Literacy, in Head Start programs. Foundations will have two main components: 1) instructional sessions that are delivered face-to-face and build teachers' pedagogical content knowledge in the physical and life sciences; and 2) a mentoring component that will support teachers as they master science content and inquiry-based methods. We are responding to the critical need for empirical evidence on effective strategies to improve preschool science instruction. Technological advances require that children today have a solid foundation in science and math to succeed in an increasingly complex world. Changing demographics demand that such strategies be effective for a growing population of English language learners, as well as low-income children, who demonstrate lower levels of science proficiency than their peers. Foundations' credit-bearing structure will benefit early childhood teachers as they respond to new requirements for higher qualifications.

To test Foundations' potential to improve teachers' practices and children's learning, we have selected stable Head Start programs in Massachusetts that share a strong commitment to improving outcomes for young children and this project. The four programs from which the participants will be sampled include: Communities United (90% low-income; 50% ELL); Montachusett Opportunity Council. (93% low-income; 27% ELL); South Middlesex Opportunity Council (98% low-income; 44% ELL); and Self Help. (100% low-income; 22% ELL). Our sample will consist of one cohort of Head Start teachers (n=72) and 420 children. We will use a pre-post experimental design and qualitative methods to address these research questions. 1a) Does the intervention impact teachers' practices in inquiry-based science instruction for children? 1b) Does the impact of the intervention vary by teacher characteristics? 2a) Do children in intervention classrooms demonstrate higher problem solving and language abilities, and more developed science concepts, facts, and process skills, compared to children in control classrooms? 2b) Does the impact of the intervention vary by children's status as ELLs? 3) How do teachers' practices influence the engagement and classroom participation of children who are ELLs? We will collect child and classroom data using a set of rigorous standardized measures. Because there are no existing assessments of science teaching and learning, we will develop new measures to advance the field. We will monitor the extent to which teachers effectively implement the intervention using a fidelity of implementation tool reflecting the principles of Foundations. To analyze quantitative data, we will use linear regression and HLM. For Q3, we will conduct in-depth program effects case studies of teachers and ELLs.

Human Subjects: Yes Exempt from Regulations: No Exemption #: Assurance #: 000000038

Exempt Narrative:

Non-Exempt Narrative:

Please See Developmental Approval Letter after the Appendices.

Estimated Funding

Federal:	\$469,919.00	Local:	\$0.00	
Applicant:	\$0.00	Other:	\$0.00	Total: \$469,919.00
State:	\$0.00	Program Income:	\$0.00	

Federal Budget

Budget Categories	Year 1	Year 2	Year 3	Year 4	Year 5	Total
1. Personnel	\$206,058.00	\$203,244.00	\$173,871.00	\$0.00	\$0.00	\$583,173.00
2. Fringe Benefits	\$56,048.00	\$55,282.00	\$47,293.00	\$0.00	\$0.00	\$158,623.00
3. Travel	\$2,679.00	\$3,231.00	\$13,610.00	\$0.00	\$0.00	\$19,520.00
4. Equipment	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
5. Supplies	\$7,952.00	\$1,248.00	\$1,298.00	\$0.00	\$0.00	\$10,498.00
6. Contractual	\$11,240.00	\$25,636.00	\$15,500.00	\$0.00	\$0.00	\$52,376.00
7. Construction	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
8. Other	\$70,200.00	\$89,465.00	\$49,791.00	\$0.00	\$0.00	\$209,456.00
9. Total Direct Costs	\$354,177.00	\$378,106.00	\$301,363.00	\$0.00	\$0.00	\$1,033,646.00
10. Indirect Costs	\$115,742.00	\$117,155.00	\$100,957.00	\$0.00	\$0.00	\$333,854.00
11. Training Stipends	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
12. Total Costs	\$469,919.00	\$495,261.00	\$402,320.00	\$0.00	\$0.00	\$1,367,500.00

Non-Federal Budget

Budget Categories	Year 1	Year 2	Year 3	Year 4	Year 5	Total
1. Personnel	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00

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2. Fringe Benefits	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
3. Travel	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
4. Equipment	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
5. Supplies	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
6. Contractual	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
7. Construction	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
8. Other	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
9. Total Direct Costs	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
10. Indirect Costs	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
11. Training Stipends	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
12. Total Costs	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00

Application Details

D-U-N-S Number: (b)(2) T-I-N: 042241718 Duration (years): 5
 Any Federal Debt: No Specify:
 Type of Applicant: Non-Profit Organization If Other, Specify:

Authorized Representative Information

AR Name	AR Address	AR Phone	AR Fax	AR E-mail	Primary
Ms. Jacqueline DeJean	EDUCATION DEVELOPMENT 55 Chapel Street Newton, MA 02458-1060 United States of America	617 969-7100	617 9691910	Jdejean@edc.org	Yes
Mr. Michael Pelletier	Education Development Center, Inc. 55 Chapel Street Newton, MA 02458-1060 United States of America	617 969-7100	617 969-1910	Mpelletier@edc.org	No

SIGNIFICANCE

In response to Goal 2 of the Teacher Quality Research—Math/Science Grants Program, Education Development Center, Inc. (EDC) is pleased to resubmit its proposal to develop, pilot test, refine, and retest *Foundations of Science Literacy*, a credit-bearing professional development program. *Foundations* is designed to enhance Head Start teachers' understanding of key principles of the physical and life sciences and enable them to apply their new knowledge to science teaching and learning in their classrooms. We thoroughly reviewed panelists' comments on our prior submission and have refined our design accordingly.

THE NEED TO FOSTER YOUNG CHILDREN'S SCIENCE LITERACY

Bowman and other contributors to Project 2061's *Dialogue on Early Childhood Science, Mathematics, and Technology Education* argue that the ability to think scientifically will be required of today's preschoolers as they mature.¹ Technological advances require that all children have access to science and math instruction in the early years.^{1,2} When today's preschoolers reach high school, 27 of the 30 fastest-growing careers—computer-related and health-related jobs—will require a solid understanding of science.³

Sadly, our P-16 educational system is not preparing students to succeed in tomorrow's labor market. Students are not demonstrating rapid progress in science achievement,^{4,5} particularly when compared with other countries.⁶ Further, an achievement gap in science persists, with children of color, some children who are English language learners, and children of low-income backgrounds demonstrating lesser science proficiency than their peers.^{4,7,8}

To foster its future workforce's science literacy, the United States needs to improve science education for *all* children, at every grade level.^{4,5,7,9-11} In David Hawkins'¹² view, science can be "the great equalizer" when it is made more accessible by basing curriculum on everyday topics that are familiar to all children, regardless of their backgrounds. Because differences in children's achievement are apparent before they enter kindergarten,¹³ realizing science's potential for educational equity can bridge the achievement gap that begins in preschool.

EARLY CHILDHOOD TEACHERS' CRITICAL ROLE AND NEEDS

There is ample evidence that high-quality early education programs help support at-risk children's school readiness.¹⁴⁻²⁰ But, while brain research shows that children are ready and eager to learn from infancy,^{13,21} many early childhood teachers are not ready to engage children in rich science experiences that lay the groundwork for later success in school and the workplace. Teachers' science knowledge is predictive of children's science learning.²² Yet, while teachers want to capitalize on children's curiosity about the world, they frequently lack confidence in their own understanding of science.²³ Often, teachers rely on "spur of the moment" planning or provide activities that are loosely connected to a theme.¹⁸ Even quality programs tend to have a strong focus on language and social development, a weaker focus on mathematical foundations, and little to no focus on developing young children's potential for scientific thinking.²⁴

Because many early childhood teachers lack formal higher education,^{25,26} professional development is key to assuring that teachers provide children with cognitively-challenging early learning experiences.^{17,18,27,28} Yet, few models of professional development build teachers' skills and knowledge in an ongoing way and provide access to higher education credits. Often, professional development consists of episodic workshops that do not reflect research-based knowledge about effective learning²⁹⁻³⁴ or build on teachers' current practice.^{30,34} Also, the busy realities, and frequent isolation of teaching young children make it hard for teachers to apply

their learning without additional guidance and support. Without ongoing feedback and content-focused mentoring, it is difficult for teachers to sustain changes in practice.^{30,35,36}

CONTRIBUTIONS TO SOLVING THE PROBLEM

Foundations of Science Literacy can answer the urgent call to prepare preschoolers for tomorrow and respond to Hawkins's eloquent plea for equity. First, in developing and studying *Foundations*, we will respond to the critical need for empirical evidence on effective strategies to improve preschool science instruction. In our review of the literature, we found no empirical studies of the impact of professional development—rich in science content—on early childhood teachers' practices and low-income children's cognitive development; those few that exist are situated in elementary grades or higher. Our experimental design will enable us to contribute new knowledge to the field—through conference presentations, journal articles, and publications—that illuminates how *Foundations* impacts teachers and preschool children.

By using complementary methodologies, we will also be able to provide a deeper understanding of how an inquiry-based approach to science affects children who are learning English as a new language. While science educators and other experts identify the potential value of inquiry to science and language learning of ELL children, the school-age level work of Fradd and Lee³⁷ raises interesting questions about the "rules of science" (p. 16) and the social dynamics of inquiry and their congruence with other cultures. They suggest that a combination of an inquiry-based science approach and direct instruction may work best for some ELL students at different points in their learning. Our research will build on Fradd's and Lee's questions and provide data on whether an inquiry-based approach to supporting scientific thinking—exposure to the science symbols and conventions^{1,2}—yields different results for preschool ELL children.

Beyond scholarship, the rigorous, credit-bearing *Foundations* program will help enhance teachers' capacity to provide children with rich early learning experiences. There is evidence that content-focused programs such as *Foundations* are needed to improve Head Start teachers' practice in key early learning areas included in the Head Start Child Outcomes Framework.³⁸⁻⁴⁰ Further, credit-bearing professional development is essential for Head Start teachers. While evidence links children's positive learning outcomes to teachers with BA degrees and specialized early childhood training, only about 30% of teachers hold a BA degree or higher.^{26,41} Currently, the Senate and House Head Start reauthorization bills have different approaches to raising teacher qualification requirements.^{42,43} Yet, the final bill will probably require more teachers to hold AA and/or BA degrees. Such a policy change will create a strong incentive for Head Start teachers to participate in carefully researched, credit-bearing professional development. Additionally, early childhood programs are already exhibiting interest in science learning. Redleaf Press reports that EDC's recently released *Young Scientist Series (YSS)* is extremely popular and gathering momentum. Furthermore, the National Association for the Education of Young Children—the early childhood community's largest professional organization—is distributing more than 25,000 units of *YSS* as a comprehensive membership offering. But unless teachers are well versed in science content and pedagogy, these curricular materials will have limited benefits. Consequently, a well-researched professional development program can be a critical factor in making the most of the renewed national interest in and concern for science education. In addition, EDC is helping to design a national, multimedia model for training Head Start early literacy mentors. Recently, the Bureau has shown interest in extending mentoring support beyond early literacy to other key early learning domains. *Foundations'* content-focused mentoring component can become a valuable resource for Head Start nationwide.

Finally, we will contribute new research tools to the field. The *Preschool Science Assessment* (PSA) will assess children's concepts, facts, and skills in the physical and life sciences; *Science Teaching Performance Tasks* (STPT) will rate teachers' pedagogical content knowledge. In addition, we will refine the *Science Teaching and Environment Rating Scale* (STERS)⁴⁴, a promising observation tool designed with NIH funding, to measure the quality of early childhood science teaching and learning environments. Currently, it is impossible to assess early childhood science teaching due to the lack of appropriate instruments. After developing, refining and testing these tools, they will be ready for the field at a pivotal time. *Good Start, Grow Smart* calls for states to develop early learning standards (ELS) that map on to K–12 content domains.⁴⁵ In the 45 states with ELS under development, 23 include science.⁴⁶ From developing the Early Language and Literacy Classroom Observation (ELLCO),⁴⁷ we know that rating instruments can be powerful factors in focusing teachers' and supervisors' efforts to improve practice.^{47,48}

RESEARCH PLAN

Over a three-year period, we propose to develop, pilot, and test a professional development program, *Foundations of Science Literacy*, for Head Start teachers in Massachusetts. In the first half of Year 1, we will develop *Foundations*, including all instructional and mentoring materials. Then, we will pilot *Foundations* with 15 teachers and use formative evaluation results to refine our approach. We will also develop and pilot test two measures: one aimed at assessing teachers' pedagogical content knowledge and a second to assess children's science learning. Year 2, working with four Head Start partners, we will carry out a research design that uses a pre-post experimental design and complementary qualitative methods. The research team will select the sample, refine the data collection plan, recruit and train data collectors, and organize data sets for analysis. In Year 3, we will use linear regression and hierarchical linear modeling (HLM) to analyze quantitative data to assess the potential of *Foundations* as a vehicle for improving science teaching and learning in the early years. Using case study methodology, we will illuminate how teachers' practices impact outcomes for English language learners. Our findings will be shared through publications, and national research conferences. We will also review project findings and materials with commercial publishers, to seek wider distribution.

DESCRIPTION OF THE INTERVENTION

OVERVIEW. *Foundations* will have two main components: 1) **instructional sessions** that are conducted face-to-face and designed to build teachers' content knowledge in specific concepts in the physical and life sciences and enhance their ability to teach science to young children; and 2) a **mentoring component** that will provide coaching support to teachers as they master science content and implement inquiry-based science methods. Based on our experience training early childhood teachers, we propose to deliver *Foundations* over a six-month period. We know that it is essential to expand the timeframe for coursework beyond that typically allotted by institutions of higher education, which allows teachers to digest and apply new material while continuing to meet their job obligations.⁴⁹

It is important to note that we have begun some initial work on *Foundations*. With a four-year grant from the National Science Foundation (NSF), we developed, field-tested, and recently finalized a set of teacher guides. A third-party evaluation of teachers' use of the guides highlights the need for an intensive and systematic approach to early childhood science professional development. The lack of teachers' education in even the most basic aspects of the physical and life sciences and their lack of pedagogical content knowledge limit the questions they ask, the

investigations they design, and the problems they pose to challenge children's thinking and advance their learning.⁵⁰ Driven by the need to support teachers' use of the guides, but lacking funds to develop an intensive intervention, we wove together a series of short-term science workshops as a stop-gap. Based on our knowledge of effective professional development, we know that the workshops cannot redress teachers' acute lack of science content knowledge. Early childhood teachers need much more than short-term science workshops. They need time and ongoing support to explore science before they can learn the content and pedagogy necessary to carry out worthwhile curriculum. While our teachers' guides and other materials will help speed *Foundations'* development, we need additional support to develop and test an intensive program.

KEY FEATURES OF THE INSTRUCTIONAL DESIGN.

Videotapes. Teachers learn best when they see examples of the practices they are adopting. Videotape exemplars, coupled with teacher commentary, build teachers' capacity to analyze and reanalyze the effectiveness of practices in light of children's responses. Powerful vehicles for showing teacher-child and child-to-child interaction, they demonstrate the complex interactions among instruction, assessment, and children's learning. As "pictures of practice," they demystify how to introduce investigations, conduct rich discussions, and identify and work with children's naïve theories. And, they build teachers' ability to engage in focused, professional dialogues.

Children's Work Samples. Young children express their science understandings and questions through conversations, drawings, narratives, and play. Yet, many teachers are not aware of the assessment opportunities that these sources of data provide. In *Foundations*, we will provide teachers with children's work samples that illustrate a range of understanding and a diversity of modes of expression. Such samples provide teachers with the experience they need to assess children's learning and prepare responsive curriculum activities that challenge children's thinking. We will also create CD-ROMS with work samples gathered from participants' assignments. Using work from their classrooms helps teachers move from "abstract" analysis, in which the children and classroom are unknowns, to "authentic" analysis in which the hypotheses they generate can be tested and reported on.

Performance-Based Assignments. Performance tasks that elicit what teachers know and are able to do help guide teachers' mastery of key concepts and strategies and assist course architects and instructors in evaluating the impact of teaching and learning events.⁵¹ Our past work for the National Board for Professional Teaching Standards (NBPTS) provided us with in-depth expertise in designing performance-based assignments, and we apply this knowledge to all of our credit-bearing professional development programs. In *Foundations*, assignments will be clearly written and carefully sequenced to build a bridge between instructional sessions and teachers' classrooms. Participants will be required to read texts, carry out application activities, set goals to improve their practice, and analyze the effectiveness of their teaching in terms of children's science learning, development, and engagement. All assignments will center on children's work and/or videotapes of teachers' practices to provide direct evidence of classroom practices that allow us to evaluate teachers' learning. Because we are interested in examining how children learning English respond to an inquiry-based approach, we will devise several assignments that require teachers to track second language learners' development and engagement.

Backstitching. In our face-to-face sessions as well as our mentoring, we expect to employ a professional development method called backstitching. Designed to encourage the reframing of prior knowledge as new concepts are learned and practicum experiences are acquired, we use backstitching at critical points during professional development when additional theoretical and/or practical information can deepen participants' understanding of key concepts.

Backstitching techniques can include reanalyzing children's work samples or video vignettes in light of new content learned, or synthesizing child assessment information over time to develop a more comprehensive picture of a child's learning. Regardless of the technique, backstitching helps participants develop a systematic approach to analyzing the steady flow of child outcome information that can influence their teaching.

DELIVERY AND CONTENT OF INSTRUCTIONAL SESSIONS. We have revised the delivery of the instructional sessions to respond to reviewers' comments and lighten the cognitive load on participants. The 42 instructional hours will be divided into eight face-to-face sessions and paced over a six-month period to allow ample opportunity for application through performance-based assignments and mentoring. Sessions will be held on Head Start's professional development days or weekends to eliminate the need for substitute teachers—a common barrier to early childhood teachers' participation. Initial sessions will concentrate more of the instructional content on teaching teachers science content using an inquiry-based approach. As the program progresses, sessions will focus more on the content and pedagogy appropriate for young children.

One four-credit course cannot turn early childhood teachers into experts in the physics involved in the properties of liquids and the biological principles governing living things. Instead, our goals for teacher learning and our selection of subject matter are pragmatic. Our objective is to provide teachers with a solid foundation of key science concepts that will enable them to guide children's learning and *not* reinforce potential misconceptions. For physical science, we will concentrate on the properties of liquids because most classrooms have water tables. For the life sciences, we will focus on the characteristics of living organisms and related concepts because of their relevance to preschool classrooms. Below we present a description of the learning goals and content of the first five sessions we will develop. A description of Sessions 3–8 appears in Appendix B, along with a more detailed sample of a block of *Session 1*.

Sessions 1 & 2: Exploring Properties of Liquids. Sessions will acquaint teachers with the properties of matter and emphasize their adult understanding of the properties of liquids and the concepts of flow, cohesion, and adhesion. Learning goals include to: 1) understand that liquids have no shape of their own and take the shape of their containers; 2) experience and understand that, due to their basic structure, liquids flow when a force is applied and this flow can be controlled and directed; 3) identify and define cohesion as a property of liquids that varies with different liquids and helps to explain the phenomena of surface tension, drops, and streams; and 4) begin to learn the nature of scientific inquiry and experience and learn inquiry-based pedagogy relevant to physical science (i.e., observe, explore, test predictions; collect, record, and analyze data; communicate findings).

The first session will introduce teachers to EDC's inquiry-based teaching approach and model a process we call open exploration. Using a water table, siphons, tubes, etc, instructors will guide teachers in exploring water's properties and noting their observations. Next, instructors will engage participants in a plenary discussion that surfaces observations, highlights common ideas about the properties of water, and identifies points of disagreement. Instructors will elicit predictions and explanations from participants regarding their generalizations, yielding an initial picture of the questions, understandings, and misunderstanding that teachers hold. A brief lecture will follow to tie participants' observations to the key science terminology and principles introduced and to make explicit science inquiry's inherent nature and process.

Session 2 will feature a series of focused explorations designed to investigate cohesion and adhesion, instructor-led discussions that provoke identification of patterns and plausible generalizations, and interactive lectures that tie experience learning to science principles.

Working in groups, teachers will study how water flows and how it behaves when flow is restricted (drops) and when placed on different surfaces (adhesion). Other investigations will be designed to examine the phenomenon of surface tension through multiple experiences (e.g., filling a container beyond its rim, floating a needle, observing a skate bug), building teachers' ability to explain what is happening at the surface of liquids and understand how these principles can help to elucidate other phenomena observed.

MENTORING COMPONENT. We will supplement class sessions with mentoring support delivered by *Foundations* instructors to participating teachers. We have selected instructors to carry out this role because our analysis of the literature on successful mentors in educational settings suggests that mentors must have strong educational backgrounds and deep content knowledge⁵² that goes beyond a theoretical understanding, and possess the pedagogical skills needed to craft effective instruction.⁵³⁻⁵⁵ They must have the functional skills to conduct classroom observations and translate their resulting insights into thought-provoking discussions with protégés.^{53,55,56} Because teachers will vary with respect to their skills and openness, mentors must be able to adapt their strategies to most effectively reach each individual.^{53,57-59}

Initially, instructors will work with teachers individually between *Foundations* sessions, planning their visits well in advance to ensure that established goals for the visits can be met. Our experience with mentoring programs with Head Start⁶⁰ indicates that hour and a half sessions work well on average. As the mentor-protégé relationship progresses and teachers are more comfortable with applying learning, we expect that mentoring will involve groups of teachers at the same site who are grappling with similar issues.

Central to our approach to mentoring are three strategies: *coaching*, *reflective documentation*, and *collaborative inquiry*. Coaching involves demonstration, observation, and feedback, which are key strategies used to help protégés learn new methods of structuring content and experiences to promote children's learning, planning more effectively for classroom instruction, and adopting more effective ways to assess children's learning. Well-conceived classroom observations incorporate pre-conferencing to set the stage for the observation, post-observation feedback that focuses on assessing what children are doing and thinking, and an opportunity for the protégé to respond to the feedback.^{52,61-64} Depending upon protégés' needs and the dynamic between the mentor and protégé, various forms of modeling, including observations by protégés of the mentor's or a peer's teaching or sharing teaching in the protégé's classroom⁶⁵ may be a more effective means of assisting protégés in reflecting upon and strengthening their practice.⁶⁶ Building in opportunities for protégés to observe many different teaching styles, compare notes, and consult at length with mentors can help advance their own practice.⁶⁷

Our mentoring component will also use a strategy we call *reflective documentation*, which can play a powerful role in supporting protégés to continually refine their practices—prompting them to summarize their experiences, identify areas to strengthen and supports needed, and report on what they have learned. Such documentation can include videotaping to support analysis of practice and various kinds of logs and journals that mentors and protégés can keep and sometimes share with each other and colleagues.^{52,59,68-70} We expect videotaping will be a particularly important form of documentation that will be useful in applying the content learned in *Foundations* class sessions. Videotape enables mentors to assess protégés' progress over time and help protégés recognize opportunities to enrich children's learning.⁶⁸ In addition, we intend to use the techniques of "dialogue journals" and "open journals" to promote reflective practice. In the former, mentors and protégés can carry on conversations about content and practice; the

latter offers a mechanism for protégés to contribute their insights to one team journal, sharing their challenges, successes, and ideas.⁷⁰

Collaborative inquiry includes approaches such as collaborative planning and study groups, and advances shared learning for individuals and groups of protégés. Planning is the most prevalent form of collaborative inquiry and can provide the greatest opportunity for job-embedded learning to affect instruction.^{55,64} By gaining input on their instructional plans, protégés can begin to discover different ways of teaching and assessing children's learning. This strategy also serves to help protégés think through how to accomplish their goals and serves to establish a shared vision of how to advance children's learning.⁷¹ For example, in Session 1, when teachers are asked in their first assignment to conduct a home experiment using different liquids, their analysis of data will be richer if their mentoring on the assignment occurs in a small group. Comparing data with that of other teachers, discussing why the results might differ, and testing those hypotheses will help to reinforce an understanding of scientific inquiry effectively.

RATIONALE FOR THE INTERVENTION

Foundations of Science Literacy's instructional design is based on research on how people learn²⁹, guiding principles of neo-Vygotskian theory, and situated cognition tradition that indicate that development occurs within activity settings as learners acquire new interconnected sets of goals, motivations, strategies, and patterns of acting.⁷²⁻⁷⁶ The cognitive apprenticeship paradigm that "systematically preserves and integrates the best of academic and vocational education into a single model"⁷⁷ encapsulates our approach to teacher education. *Foundations* participants will serve as "cognitive apprentices,"^{78,79} receiving expert guidance and mentoring as they engage in multiple, hands-on strategies—analysis of children's work samples, video reflection and analysis, performance-based assignments—that require them to constantly apply their new knowledge of physical and life sciences and theories of learning and development to their classroom practice. In turn, participants will master the cognitive apprenticeship model and support children's emergent scientific literacy by adopting teaching methods that will give children "...the chance to observe, engage in, invent, or discover expert strategies in context."⁷⁷

In addition to these conceptual underpinnings, the intervention's format and content is based on current research that suggests the key elements of effective professional development and inquiry-based physical and life science education in the early years.

EFFECTIVE PROFESSIONAL DEVELOPMENT. A recent, large-scale empirical comparison of the effects of professional development on teachers' learning indicates that effective programs: set clear goals for teachers' learning and student outcomes; offer related experiences over time; focus on subject matter; build on teachers' current practice and knowledge; allow teachers to integrate their learning into their classrooms; provide opportunities for ongoing support, feedback, and reflection; and include time for teachers to collaborate with colleagues on an ongoing basis.³⁶ These findings support literature on the characteristics of successful professional development.^{29,80-83} *Foundations* will contain all of these elements.

As noted above, we will support teachers as they move from theory to practice, capitalizing on their experience and offering them opportunities to connect the ideas and approaches explored in class to their own practice—a key aspect of internalizing and applying learning.^{30,34} We will also provide multiple occasions for reflection, and help create learning networks among participants that will support their ability to share "the wisdom of practice."⁸⁴ As they practice applying their knowledge and discuss their efforts with peers, teachers will generalize their understanding, "unbinding" it from the specific situation within which they experience it.^{73,78} During course sessions, teachers will learn to work collaboratively on problems they encounter. They will

explore collaborative models of professional development—first with instructors and then with a gradually widening group of colleagues. As a result, we will show participants how to create communities of practice in which teachers share a common vision and language of teaching and learning—building new habits of communication that focus on practice.^{85,86}

Content-Focused Mentoring. A growing body of literature^{64,87,88} identifies the potential of content-focused mentoring, a key component of *Foundations*, to foster the professional growth of practicing teachers. Content-focused mentoring promises to be a powerful professional development mechanism because it can help teachers implement and sustain innovations in their practice over time.^{30,36,87,89,90} The role of the mentor as “educational companion”⁶¹ focuses on helping teachers build a deeper understanding of how theory connects to practice.

INQUIRY-BASED PHYSICAL AND LIFE SCIENCES CONTENT. *Foundations* is rooted in research that points to the efficacy of inquiry-based science in building children’s problem-solving skills and scientific thinking. Science education can offer a powerful way to exploit children’s conceptual capacities while tapping their natural curiosity about the world.^{18,91-94} Inquiry-based science also can provide children with opportunities to explore, experiment, hypothesize, and problem-solve, all of which are foundational to their intellectual maturation.^{17,18,27,92,95-97}

In addition, the social nature of inquiry-based science draws heavily on discussion of observations and problem solving. Not only do these discussions lead to more advanced understandings of science concepts,⁹⁸⁻¹⁰⁰ they also positively affect children’s language and literacy development.¹⁰¹⁻¹⁰⁴ In developing the content of *Foundations of Science Literacy*, we will seek to advance teachers’ capacity to deepen children’s understanding of the world and confront their naïve theories about the way it works. This does not mean simplifying academic curriculum intended for older children. Nor does it mean teaching children scientific methods (i.e., isolating variables, comparing quantities, formulating explicit principles) or correcting children’s incomplete understandings. Rather, it involves providing young children with opportunities to build on their curiosity and interest in how the world works by exploring meaningful physical and life sciences concepts in the context of their experience and play.⁹⁴ As Lind⁹³ notes, “science is an active enterprise . . . a process of finding out and a system for organizing and reporting discoveries” (p. 73).

Key to such an approach is the development of a kind of cognitive apprenticeship between teacher and child, with the teacher as a facilitator of children’s inquiry and the child actively engaged in exploring materials and phenomena in-depth over time; collecting and analyzing data; reflecting on their experiences; and thinking through discussion and representation.^{92,105} Provoking children to reflect on their ideas helps them to examine their thinking, which in turn leads them to discover gaps and to repair implausible theories.¹⁰⁶⁻¹⁰⁸ It is important for children to repair a theory rather than discard it, or the discarded theory will return at a later date.^{109,110} But, the inquiry process cannot be the only focus; inquiry must have an object, an “it” as David Hawkins¹¹¹ defines it. In order for teachers to ask probing questions and design experiences that challenge children’s naïve theories, they must first be comfortable and confident with the critical science concepts being investigated. While many teachers want to extend these processes, they often feel uncertain of their own grasp of science and scientific inquiry.²³ In order to effectively guide content-rich investigations, they must first explore their own science-related questions.^{112,113} *Foundations* will help teachers experience key concepts first-hand, so they can gain a sound understanding of the underlying science principles.

SMALL-SCALE PILOT OF *FOUNDATIONS*

We will conduct a small-scale pilot of *Foundations* with 15 teachers to guide revisions for Year 2 delivery. We will work with Action for Boston Community Development (ABCD), a large Head Start program that has been a knowledgeable research partner with EDC for almost 5 years. (See Appendix A for letters of agreement.) ABCD serves primarily low-income families and enrolls a significant number of English language learners, mirroring our sample in Year 2. The main purpose of the pilot is to test the organization and delivery modes of the intervention. In particular, we are interested in gathering information that will help us:

- Examine the alignment of learning goals with the learning activities
- Assess the scope and sequence of the learning activities to ensure they fit within the timeframe allotted and build effectively on one another
- Evaluate the relevance and clarity of texts and other materials (e.g., assignments)
- Assess the level of difficulty for teachers by examining the relationship among various organizational aspects such as pacing, density of material, and level of detail of material
- Assess the barriers and patterns of use of the *Foundations* mentoring component

The research team will use a range of methods associated with formative evaluation, including observations, teacher and instructor interviews, document review, and brief questionnaires. To ensure that the pilot study fosters continuous improvement and refinement of *Foundations*, researchers will meet regularly with developers to share preliminary findings.

OBSERVATIONS. Two members of the research team will attend each of the four instructional sessions in order to document the actual delivery of the intervention and assess participants' level of engagement and participation. In addition, researchers will visit each teacher's classroom at two points in time over the six month intervention to assess how *Foundations* content and strategies are being used. To guide classroom observations, we will use the Science Teaching and Environment Rating Scale (STERS).

INTERVIEWS. The research team will conduct interviews to gather data about both program components: instructional sessions and mentoring. Interviews will be semi-structured, combining a conversational strategy within an interview guide approach. This hybrid method will ensure systematic data collection and consistency of inquiry, while allowing the interviewer the freedom to pursue topics of interest in depth.¹¹⁴

DOCUMENT REVIEW. Review of documents will provide vital information about design and delivery of *Foundations*. The draft instructors' guides for each session will be examined for their clarity, flow, and alignment. This written documentation about the instructional component of the intervention will be analyzed in light of observational data taken by the research team. Changes and discrepancies will serve as the basis for semi-structured interviews with instructors following each session. Mentor-protégé journals and logs will also be analyzed for information about participant engagement and the nature of the discourse. Samples of completed assignments will also be reviewed.

QUESTIONNAIRES. Researchers will develop a set of brief questionnaires to be administered after each session. Participants will be asked to rate aspects of the design (e.g., utility of each learning activity) and delivery (e.g., the clarity of instruction, focus of discussions). A similar set of questionnaires will be tailored to gather information about mentoring. These instruments will combine open-ended questions and Likert-type items.

DATA ANALYSIS. Open ended questions and responses to interview questions will be investigated for similarities and differences among participants in order to surface patterns that would help inform the revision process. Quantitative data from the STERS and questionnaires

will be analyzed for trends that we may discover through descriptive statistics. We will look at the distribution of responses, measures of central tendency, and dispersion.

A Year 1 pilot test of new instruments we propose to develop appears later in this section.

RESEARCH QUESTIONS

We will address the following research questions using a combination of quantitative and qualitative methods:

- 1a) Does the intervention impact Head Start teachers' practices in inquiry-based science instruction for four-year-old children?
- 1b) Does the impact of the intervention vary by teacher characteristics such as education and experience?
- 2a) Do children in intervention classrooms demonstrate higher problem solving and language abilities, and more developed science concepts, facts, and process skills, compared to children in control classrooms?
- 2b) Does the impact of the intervention vary by children's status as English language learners?
- 3) How do teachers' practices, as embodied in the intervention, influence the engagement and classroom participation of children who are English language learners?

QUANTITATIVE RESEARCH DESIGN

STUDY SAMPLE. To test the effectiveness of *Foundations*, we have selected four Head Start programs that share a strong commitment to improving outcomes for young children and for this undertaking. See Table 1 for program characteristics. Communities United, Inc. (CUI) has served the children and families of Waltham, Massachusetts since 1970. Its goal is to deliver high-quality comprehensive services to low-income children in nine communities. Montachusett Opportunity Council, Inc. (MOC) has served low-income preschoolers in north central Massachusetts for more than 35 years. Self Help, Inc. has been in existence since 1965 and serves southeastern Massachusetts. South Middlesex Opportunity Council (SMOC) Head Start, also part of a Community Action Agency, was established in 1966. Head Start is one of the many programs SMOC offers with the goal of improving the quality of life for low-income families in the Framingham area. All programs are characterized by strong management and leadership and offer a stable context in which to study the impact of our intervention. It is important to note that three programs had no teacher attrition in the past two years and one program had two teachers leave for public school positions over the same period.

Table 1: Program Characteristics

Program	# Centers	# Teachers of 4 Year Olds	# 4 & 5 Year Olds in Center-Based	% Low-Income	% ELL
CUI	9	20	166	90%	50%
MOC	12	27	331	93%	27%
SMOC	9	22	248	98%	44%
Self Help	12	38	400	100%	22%
Total/Average	42	107	1,145	95%	36%

Description of and Rationale for Study Sample. Our sample is drawn from the four Head Start programs described above because they have a sufficient number of teachers and linguistically diverse children to assure an adequate sample. In addition, we constrained the

program type to Head Start in order to factor out some of the unforeseen bias that can occur when drawing from a generic pool of early childhood programs. Table 2 presents the sampling plan for teachers and children.

Teacher sample. For analysis of teacher outcomes, we calculated the number of teachers needed to detect a medium effect size using multiple regression analyses with two predictors at Power=.80 for $\alpha=.05$. We determined that our teacher sample should include an estimated 67 teachers.¹¹⁵ However, taking into account a 5% attrition rate among teachers over the course of the one-year intervention, we built an additional 5% into our targeted recruitment sample. In August 2006 (Year 2) we will recruit teachers from each of the four programs for a total recruitment sample of 72. Our goal is to have a balanced sample of teachers across the programs, so we will seek to recruit 18 teachers from each.

Child sample. Our child sample is limited to 4- and 5-year-old children, so teachers who teach only 3-year-olds will be ineligible to participate. We have limited the study to 4- and 5-year-old children as the assessment of English proficiency that is most appropriate and robust for preschool children (Pre-LAS) is normed on children four years old and older. Within the classroom of each teacher in the teacher and child-level data sample ($n=42$), children will be stratified by English language learner status. To draw the English language learner sample, proportional sampling will be used, based on the average percentage of English language learner children across all programs (38%). As displayed in Table 2, in the intervention condition 95 children will comprise the English language learner sample and 155 children the non-English language learner sample. In the control condition, there will be an estimated 65 English language learner children and 105 non-English language learner children. Assuming a 10% attrition rate over the course of the year for children, the final sample will consist of 378 children.

Random assignment. For analysis of child outcomes, using hierarchical linear modeling, we calculated the sample size needed to detect medium effects at Power=.80, $\alpha=.05$, $\rho=.30$ using Optimal Designs.¹¹⁶ Analyses revealed a needed sample size of 42 teachers with an average of 10 children per classroom.^{117,118} Therefore, we plan to collect child-level data in 42 teachers' classrooms. These 42 teachers will be randomly selected from the recruitment sample ($n=72$).

Within each of the two data collection conditions described above (Teacher-level data only $n=30$; Teacher and child-level data $n=42$), teachers will be randomly assigned to intervention and control conditions. As indicated in Table 2, we will employ a randomized sample that is not balanced for numbers of children and classrooms in the intervention and control groups.¹¹⁹ There are several advantages to using an imbalanced sample, including cost savings, improving design to increase power, and limiting the number of individuals who potentially will not benefit from the intervention.¹²⁰ Moreover, an imbalanced sample "reduces the precision of the impact estimates by just 2%" (p. 33) when they employ a 60:40 ratio.¹²⁰ Using this 60:40 ratio, a total of 43 teachers will be assigned to the intervention condition and 29 teachers to the control condition.

Table 2. Sampling Plan

	Intervention		Control		Total
Teachers	43		29		72
Teachers w/Child Data	25		17		42
	Intervention		Control		Total
	ELL	Non-ELL	ELL	Non-ELL	
Children	95	155	65	105	
Total	250		170		420

We will conduct a check on random assignment by examining the means and distributions of child and teacher characteristics to verify that there are not significant differences between the intervention and control groups. Any differences will be converted to a standardized mean difference to ascertain their relative importance. We will include any characteristics with moderate to large mean differences as variables in our analyses.

DESCRIPTION OF AND RATIONALE FOR MEASURES. To assess the impact of *Foundations* on teachers and children, we have selected existing measures and plan to develop two new ones, as suggested by the review panel.

Existing Standardized Instruments. While no existing standardized instruments provide direct and valid information on science teaching and learning for this age group, we have selected general measures of classroom practices and children's cognitive and language development to assess the critical prerequisites to these activities. Furthermore, in combination with more specific measures discussed below, existing instruments will be used to assess the cognitive and linguistic benefits of engaging in science inquiry. Measures selected are aligned with recent reports and findings concerning the most reliable and valid measures in early childhood assessment.¹²¹⁻¹²³ Table 3 in Appendix A presents each tool, the constructs assessed, and their psychometric properties.

In order to obtain a measure of global classroom quality, we will use three subscales of the ECERS-R: Language and Reasoning, Activities, and Interaction.¹²⁴ To assess young children's learning, we have selected a set of robust tools that examine children's mathematical reasoning and language development, which are integral aspects of the inquiry process and science learning. We will use two mathematical reasoning subscales of the Woodcock-Johnson III (W-J-III)¹²⁵ and the Auditory Subtest of the Preschool Language Scale, Fourth Edition (PLS-4).¹²⁶ To assess children's language dominance, we will administer the pre-LAS 2000¹²⁷ to all English language learners. The Spanish version of the W-J-III¹²⁸ and the PLS-4¹²⁹ will be used with children who are Spanish dominant.

Development of New Instruments. We will refine a classroom measure developed through an NIH grant, the Science Teaching and Environment Rating Scale (STERS)⁴⁴; we will also develop new teacher performance and child assessment instruments. While developing a new suite of valid and reliable instruments for the teaching and learning of domain-specific scientific knowledge is a long-term enterprise, it is necessary to gauge the impact of *Foundations* and to make progress in science education as a whole. Four principles will inform our development process: 1) the delineation of a rigorous conceptual framework for what constitutes knowledge and learning of science; 2) the use of EDC's applied knowledge about how to implement performance-based assessment tools; 3) a commitment to an iterative process of development, whereby the conceptual framework informs the application of pilot assessments, and vice versa; and 4) the use of ancillary materials, such as work samples, as a validity check on the development process.

Conceptual framework. During Year 1, in consultation with our advisors, we will take a systematic, learnability-inspired approach to developing the conceptual framework.¹³⁰ First, we will use established scientific theory and cognitive studies of scientific reasoning in order to develop an explicit model of the final knowledge state. Second, we will review the literature on naïve theories of matter and life sciences, to develop an explicit model of children's initial knowledge state and biases. Third, we will infer details about the learning processes that bridge the initial and final knowledge states, drawing on existing studies of scientific learning in the domain,¹³¹⁻¹³³ plus our own analyses of work samples and data from the current draft of the

STERS.⁴⁴ In particular, we will seek to identify typical developmental trajectories and the hallmarks of conceptual restructuring during development. Fourth, we will adopt an appropriate formalism for representing concepts, propositions, processes, and their dependencies. A possible formalism is John Anderson's ACT-R model, which already represents these knowledge structures, and has been developed and empirically validated over many years.¹³⁴⁻¹³⁶

Our conceptual framework is already informed by the assumption that scientific knowledge is partly "declarative" (i.e., knowledge that can be explicitly stated, such as the concept of "density" or the proposition that "the capacity of an object to float depends on its shape") and partly "procedural" (i.e., "how to" skills that can be demonstrated but not explicitly stated; e.g., the actual ability to *make an inference* about the capacity of objects to float based on observing a variety of different objects float or sink). In general, science process skills are essential to the generative quality of true scientific ability: they enable learners to acquire new concepts, combine concepts into propositions, and integrate propositions into coherent, dynamic mental representations of scientific discourse. Categories of science process skills include observation (e.g., looking at something; counting how often it occurs), "experimentation" or testing (causing something to occur, with the intent of understanding it), and scientific discourse or conversation (e.g., drawing conclusions on the basis of evidence; revising those conclusions). In addition, scientific process skills and knowledge may sometimes be expressed by what teachers and children do rather than what they say. (See Table 4, Appendix A, for more detail.)

Our conceptual framework also makes assumptions about the growth of scientific knowledge. Robust findings in cognitive science and science education^{92,137-141} show that the progress of children and their teachers in mastering scientific knowledge is not a gradual, monotonic accumulation of concepts, propositions, and process skills; instead, we know that progress is often blocked indefinitely by misconceptions based on naïve or intuitive theories of a phenomenon, until—with effective teaching—a learner is able to *restructure* his or her understanding of the domain. For example, young children often believe that objects float in water because they are lighter than water, and this misconception may persist well into adulthood. Because this naïve conception is a genuine obstacle to scientific problem solving, a critical function of the framework will be to define such obstacles and elucidate the circumstances under which they are overcome. We expect to find that a child's progress in mastering science will depend on changes in how information is generated and encoded, and ultimately, in the mental representation of the problem itself.

Classroom measures. As the conceptual framework is developed during Year 1, we will also iteratively modify specific STERS items, bringing them more in line with our overall assessment strategy. In addition, we will create four performance tasks designed to assess teachers' pedagogical content knowledge⁸⁴ in this area, including their ability to analyze a child's grasp of scientific concepts and processes, and to generate the next steps for instruction along with a rationale for their plans. In one exercise we might present teachers with a set of children's observational drawings as stimulus material and ask them to make plausible inferences about children's understandings and incomplete understandings of key concepts in the life sciences. By using a set of children's work samples we can also elicit what teachers might plan to do to further children's learning. We will pilot test these tasks in Year 1 with participating teachers and refine the prompts and scoring rubrics for use in Year 2.

Child assessment measures. The conceptual framework will also play a critical role in the development of a pilot child assessment instrument. We expect that towards the end of Year 1, the framework will support the pilot testing of specific sub-tasks of the instrument with a sample

of children enrolled in ABCD, and that a complete draft of the instrument will be ready for full-scale pilot testing in Year 2. Although the exact nature of the instrument cannot be specified at this time, we anticipate that different assessment formats will be used to elicit declarative and procedural knowledge, to encourage linguistic and non-linguistic responses, and to support a broad range of quantitative and qualitative analyses. For example, a forced-alternative procedure, involving presentation of different objects, may provide us with a quantitative measure of how children conceptualize the relevance of an object's attributes to its ability to float. In other cases, we will work with children at the water table, presenting them with open-ended problems to test their science process skills (e.g., how is it possible for the same object to float in one liquid, but sink in another?).

DATA COLLECTION PROCEDURES. Teacher and child data will be collected in the fall and spring of Year 2. We will recruit data collectors from graduate programs in psychology and child development through our network of colleagues at area colleges and universities and from our cadre of interns contributing to other research initiatives. Data collectors selected to conduct classroom observations will receive three days of training using videotape and field-based practice. Their inter-rater reliability will be established following their intensive training. In addition, the co-principal investigator will conduct field calibrations to limit rater drift. We will select a different cadre of child assessors, half of whom will be bilingual (English and Spanish fluent); they will receive two days of training.

FIDELITY OF IMPLEMENTATION. It has been found that adoption and implementation are not synonymous.¹⁴² For example, teachers participating in *Foundations* can in theory adopt the principles and strategies, but may not necessarily implement them in the ways in which they were intended. Therefore, it is critical to examine actual implementation versus planned implementation.¹⁴³ We will thus evaluate the fidelity of implementation of *Foundations* using a three-pronged approach. First, we will have researchers conduct observations twice a year in each intervention classroom. They will use an observation tool that is aligned with *Foundations'* strategies and principles to assess how teachers are implementing the intervention. It will also assess teachers' ability to facilitate the inquiry process and to encourage children's reflections through appropriate use of children's representations (e.g., drawings, dictations, constructions) and through science talk. This tool will be adapted from the Fidelity of Implementation Review Form.¹⁴⁴ We will pilot the tool at ABCD Head Start.

To supplement classroom observations, we will also collect and analyze videotapes of teachers implementing the concepts and practices embodied in *Foundations*. We will ask teachers to videotape themselves twice a year as they engage in small group discussions with children around science. Our goal with these videotapes will be to collect data on multiple occasions as teachers implement the curriculum. We will analyze and code these videotapes using similar criteria as described above for the classroom observations as a way to determine the fidelity with which teachers are implementing the intervention. Videotapes will be coded using NUD*IST software.¹⁴⁵

Finally, we will ask teachers to keep logs on their implementation of *Foundations* activities. We will organize logs according to scope and sequence of the professional development in order to limit the time and paperwork burden on teachers. Teachers will be asked to 1) identify the focus or content of the science activity; 2) record the amount of time devoted to the activity; and 3) relate the context of the lesson (e.g., whole group versus small group). Teacher logs will be examined to determine the intensity with which teachers are implementing the intervention. If there is substantial variation in the level of implementation across teachers, data from the teacher

logs will be used to create a “level of implementation” variable for use in our quantitative analyses.

ANALYSIS PLAN. We will examine the impact of *Foundations* on teacher outcomes using hierarchical linear regression and on child outcomes using hierarchical linear modeling (HLM). We will use HLM (as embodied in the HLM5 software program) for the child outcome analyses because children are nested within teachers. HLM is the technique of choice when the sampling design results in lower-level units nested within higher-level units because it takes into account the interdependencies among levels. HLM is also favored because it permits the variance in the outcomes to be decomposed into multiple sources (e.g., child and classroom characteristics).^{146,147}

For both the teacher and child outcomes, our analysis will begin with analyzing the descriptive statistics, including the distribution shape, for all outcome variables. Any outcome variable that demonstrates a non-normal distribution will be linearly transformed. Below, we describe the process we will follow in answering each of our research questions.

Analysis of Questions 1a and 1b. *Question 1a:* Does the intervention impact Head Start teachers’ practices in inquiry-based science instruction for four-year-old children? *Question 1b:* Does the impact of the intervention vary by teacher characteristics such as education and experience? To answer Questions 1a and 1b, we will conduct a hierarchical linear regression analysis for each of the three teacher outcome variables: STERS, ECERS-R, and the Science Teaching Performance Tasks (STPT). The outcome variable for each analysis will be a change score calculated by subtracting fall scores on a measure from spring scores on that measure. Because teachers were randomly assigned to the treatment and control conditions, we do not expect there to be any differences in fall scores between the two study conditions. Before conducting our analysis, we will check for such a difference in each outcome using an independent samples t-test. Each hierarchical linear regression analysis will include a test for moderating relationships. The two moderator variables we have hypotheses about are teachers’ level of education and teachers’ years of experience.

For each of the two regression analyses, in step 1 we will add the treatment variable as a dummy variable (0 = control group and 1 = treatment group); in step 2 we will add the moderator variable; and in step 3 we will add the interaction term between the treatment variable and the moderator variable.¹⁴⁸

For analysis of teacher outcomes, we calculated the number of teachers needed to detect a medium effect size using multiple regression analyses with two predictors at Power=.80 for $\alpha=.05$. We determined that our teacher sample should include an estimated 67 teachers.¹¹⁵

Analysis of Questions 2a and 2b. *Question 2a:* Do children in intervention classrooms demonstrate higher problem solving and language abilities, and more developed science concepts, facts, and process skills, compared to children in control classrooms? *Question 2b:* Does the impact of the intervention vary by children’s status as English language learners? To answer Questions 2a and 2b, prior to testing the HLM models, exploratory analyses will be conducted to examine the nature of the data. Correlations will be performed between continuous dependent and independent variables (e.g., fall scores with spring scores on a particular outcome). Then, ordinary least squares analyses will be performed for each teacher (i.e., classroom) to detect whether or not any outlying values exist in the regression parameters.

For our HLM analyses, we propose a 2-level model for each child outcome variable. Each model will examine children nested within teachers, with spring child outcomes modeled as a function of fall scores, child, teacher and design characteristics.

As an illustration of the analysis we plan to conduct we present a two-level model to predict spring scores on the Woodcock-Johnson III Applied Problems and Quantitative Concepts measure (WJ III). We will examine WJ III scores of individual children as a function of child-level characteristics at Level 1 and teacher and classroom characteristics at Level 2. Because random assignment to conditions will take place at the teacher level, children will not be randomly assigned to conditions. Instead, they will be clustered within teachers. Therefore we will include children's fall scores as a covariate in Level 1 of this model, as included in Equation 1 below, to control for initial differences in ability level across treatment groups. Other covariates we will consider testing at Level 1 include child race and mother's level of education.

In equations 1-3 below, the subscript 'p' represents an individual child, and the subscript 't' represents an individual teacher (i.e., classroom). Each teacher (classroom) has a mean and a slope. In Equation 1, β_{0t} represents the mean score on the outcome for teacher t (i.e., the expected spring score for child 'p' in teacher 't's classroom for a student whose fall score is zero); the fall score for the WJ III will be mean centered to make the intercept a meaningful number. β_{1t} represents the slope for the outcome for classroom 't' (i.e., the expected change in spring score for each increase of 1 in the fall score). r_{pt} represents the contribution of child 'p' in teacher 't's classroom to child 'p's outcome score.

$$\text{Level 1:} \quad \text{Spring WJ}_{pt} = \beta_{0t} + \beta_{1t} (\text{Fall WJ}_{pt}) + r_{pt} \quad (1)$$

$$\text{Level 2:} \quad \beta_{0t} = \gamma_{00} + \gamma_{01} (\text{Foundations}_t) + u_{0t} \quad (2)$$

$$\beta_{1t} = \gamma_{10} + \gamma_{11} (\text{Foundations}_t) + u_{1t} \quad (3)$$

Equations 2 and 3 model variation in intercepts and slopes across teachers/classrooms. These two level-2 equations include a dummy coded treatment variable, Foundations, to represent the two treatment conditions in this study. The value of this variable will be 1 for a teacher participating in the treatment condition and a 0 for a teacher participating in the control condition. γ_{00} represents the average classroom mean for the control condition; γ_{01} represents the mean difference in spring scores between the treatment and control conditions. γ_{10} represents the average fall score-spring score slope for the control condition; γ_{11} represents the mean difference in fall score-spring score slopes between the treatment and control conditions.

After testing the effect of Foundation on child outcomes in the model described in equations 1-3, the child ELL status variable will be added. ELL will be added as a dummy variable at Level 1, with a 0 indicating English as a first language and 1 indicating that English is not the child's first language. We do not wish to control for this ELL variable, but to determine whether the effect of the intervention on children varies as a function of children's ELL status. This is a cross-level interaction between the treatment variable at Level 2, and the child's ELL status at Level 1.

For analysis of child outcomes, using hierarchical linear modeling, we calculated the sample size needed to detect medium effects at Power=.80, $\alpha=.05$, $\rho=.30$ using Optimal Designs.¹¹⁶ Analyses revealed a needed sample size of 42 teachers with an average of 10 children per classroom.^{117,118}

CASE STUDY RESEARCH DESIGN

Case study research will be used to address **Question 3:** How do teachers' practices as embodied in the intervention influence the engagement and classroom participation of children who are English language learners? We will conduct in-depth program effects case studies of teachers and children who are English language learners in a total of five classrooms in Year 2. Program effects case studies are suited for determining reasons for observed effects,¹⁴⁹ and it is our intent

to complement our quantitative analyses with rich portraits of *Foundations* classrooms that illustrate effective implementation.

CASE STUDY SELECTION. Our unit of analysis will be the classroom, focusing specifically on children who are English language learners and the teacher as they interact around *Foundations* activities. We will use purposeful sampling¹⁵⁰ to ensure that our case studies focus on accomplished teachers who are implementing *Foundations* at high levels of fidelity. Other factors that we will take into account in our selection will be the number of children who are English language learners in the classroom, the number of languages spoken in the classroom, the teacher's native language, her race and ethnicity, and her interest in and desire to participate in the investigation.

Data Collection. We will use a variety of data-gathering strategies that will be guided initially by hypotheses about the essential features of the curriculum that affect the social integration of children who are English language learners and the outcomes that emerge during the pilot study. This triangulation of data collection provides validation of our findings while eliminating potential bias.¹⁵¹ Our data-gathering strategies will include: 1) classroom observations focused on teachers' instructional practices and strategies as they interact with children who are English language learners during *Foundations*; 2) classroom observations focused on children who are English language learners as they interact with the teacher, other English language learners, and native English-speaking peers; 3) photographs of the classroom environment; 4) videotapes of small group discussions to supplement classroom observations; 5) semi-structured interviews with teachers focusing on their beliefs and practices around working with children who are English language learners within the context of *Foundations*; and 6) review of the representations (drawings, dictations, constructions) that children who are English language learners produce during *Foundations*.

Data Analysis for Question 3. To answer question 3, we will code for specific themes. Themes for classroom observations include the teacher's ability to encourage young children's inquiry, teacher's ability to deepen children's understanding of particular science concepts through selection of appropriate materials, and teacher's facilitation of children's investigation and science focused conversations. Themes for the structured interviews will capture teachers' ability to select appropriate science content, to define goals for science learning and to integrate in-depth science investigations into the curriculum. Similarities and differences will be investigated within and across observations and interviews. We will use a qualitative software package, NU*DIST, to analyze interview, observation, and other qualitative data. This software will help us maintain, review, and analyze our data efficiently.

Our multiple data collection methods and sources will allow us to triangulate data to clarify meaning and verify themes through the repeatability of an observation across data sources.¹⁵² Conclusions from the qualitative data will be integrated with findings from the quantitative data, to present a fuller picture of what is happening in classrooms implementing the intervention.

PERSONNEL

We have assembled an outstanding research and intervention team to carry out the proposed project. Our research team has been greatly enhanced by adding the expertise of a cognitive scientist, as recommended by the first review panel. His contributions already have strengthened this resubmission, as they will the project should this application be successful. We have also added a group of prominent advisors who will assist in developing the intervention and new

assessments as well as provide expertise in research methodology. Advisors' letters of agreement are in Appendix A; curricula vitae follow for key staff and advisors.

RESEARCH TEAM

Dr. Nancy Clark-Chiarelli (Year 1: (b)(6) time; Year 2: (b)(6) time; Year 3: (b)(6) time), principal investigator, will have overall responsibility for the research design, data analysis, and dissemination of project findings. She leads and contributes to complex, multi-site research projects that examine the impact of professional development interventions on teachers' practice and children's learning. She will draw on her extensive background in conducting large-scale national projects and her sophistication with a range of research methods to lead this effort. As PI of the *New England Head Start Quality Research Center*, she works with a consortium of seven other research institutions, conducting in-depth longitudinal research on Head Start programs, employing a quasi-experimental design, that uses classroom-level variables to explain variation in young children's learning. Earlier she investigated the impact of classroom quality on the literacy and social development of 400 preschool children from diverse language backgrounds, using multi-level models. As the PI of a project funded by NIH, she completed the beta testing of the *Science Teaching and Environment Rating Scale*—a tool to be refined and tested in the proposed project. Dr. Clark-Chiarelli regularly presents at national conferences and publishes her work in books and periodicals such as *Learning Disabilities Quarterly* and *Applied Psycholinguistics*. She earned her doctorate from Harvard University School of Education.

Dr. Jesse Gropen (Year 1: (b)(6) time; Years 2:&3: (b)(6) time), co-principal investigator will work closely with the PI to refine the research design, oversee data collection, conduct analyses and disseminate findings. He will take lead responsibility for the development of two measures to assess science teaching and learning. Dr. Jess Gropen is an accomplished cognitive scientist specializing in the relationship between language and thought, particularly as that relationship changes throughout development. His research interests include language acquisition, cognitive psychology, and lexical semantics. Skilled in a range of qualitative and quantitative methods, Dr. Gropen is currently a senior research associate overseeing a longitudinal study of the impact of a program-wide professional development approach. Before joining EDC, he was an Assistant Professor of Psychology at McGill University where he directed the Laboratory for Language and Memory for eight years. He has published his work in books and prestigious journals including *Cognition*, *Journal of Child Language*, and *Cognitive Linguistics*. Dr. Gropen earned his PhD at MIT in cognitive science, working under the supervision of Dr. Steven Pinker.

Dr. Miriam Smith (Year 1: (b)(6) s; Year 2: 35 days; Year 3: 30 days), senior research associate, will work closely with the Co-PI on design of the new instruments to assess science teaching and learning and assist with the dissemination of findings. For more than 15 years, Dr. Smith has conducted long-term research and developed effective approaches to improving early childhood education. She has extensive expertise in assessment design, performance task development, science teaching and learning, language development, and discourse analysis. While at the Hiatt Center, she examined the acquisition of science concepts and the role of scientific discourse in science learning in early childhood and university classrooms. She earned her doctorate in education from Clark University.

Dr. Costanza Eggers-Pierola (Year 1: 25 days; Year 2: 35 days; Year 3: 30 days), senior research associate, will play a leadership role in examining the engagement and learning of Latino children participating in the intervention. An accomplished qualitative researcher, Dr. Eggers-Pierola earned her doctorate from Harvard University School of Education. She has provided leadership and direction to a range of projects designed to promote high-quality

educational services to all children, including a study of the impact of science, math, and technology reform efforts in the state of New York.

PROFESSIONAL DEVELOPMENT TEAM

Ingrid Chalufour (Year 1: (b)(6) time; Years 2: 55 days; Year 3: (b)(6) % time), senior professional development specialist, will lead the development and delivery of *Foundations*. Co-author of the *Young Scientist Series*, she has in-depth knowledge of effective teacher education and professional development that combines content and pedagogy. She plays a leadership role in many of EDC's innovative professional development initiatives for early childhood educators, including serving as a lead developer for the credit-bearing *Excellence in Teaching* program and the instructional design for mentoring for Head Start nationwide. She also served as senior advisor in the development and testing of *Science Teaching and Environment Rating Scale*.

Karen Worth (Year 1: 20 days; Years 2&3: 10 days), senior professional development specialist, will contribute to the development and refinement of *Foundations*. As a senior scientist, Ms. Worth has been a leader in advancing science education reform for more than 30 years—contributing to the *National Science Education Standards*. She has been a principal investigator on numerous NSF projects and is a co-author of the *Young Scientist Series*.

PROJECT ADVISORS

We are pleased to add the expertise of four distinguished advisors to this effort. Dr. Rochel Gelman and Dr. Susan Carey are both prominent cognitive scientist who have conducted research in the area of preschool science learning. Dr. Carey is the Morss Professor of Psychology at Harvard University and has lead numerous studies on early cognition and concept acquisition. Dr. Gelman is the co-director of the Rutgers Center for Cognitive Science, where she continues to lead work on causal and quantitative reasoning. As Director of Early Childhood Research and Development at ETS, Dr. Jacqueline Jones's work focuses on the study of assessment in early childhood, which has earned national attention for its rigor and innovation. Dr. Aline Sayer, associate professor of psychology at the University of Massachusetts, is nationally-recognized expert in the measurement of change in longitudinal data and multi-level modeling. As a developmental psychologist and nationally known methodologist she will contribute her expertise on examining interventions designed for children-at-risk.

RESOURCES

Founded in 1958 by faculty from the Massachusetts Institute of Technology, EDC is an international non-profit organization that builds bridges between research, policy, and practice. EDC manages more than 350 projects in 40 countries, one-third of which are research and evaluation initiatives. Our work strengths nearly every facet of society, including early child development, K-12 education, health promotion, workforce preparation, community development, learning technologies, basic and adult education, and institutional reform.

EDC conducts its activities primarily under grants or contracts, with annual revenues approaching \$100 million. EDC's headquarters are located in Newton, Massachusetts, where the organization leases 161,000 square feet of space including conference rooms and facilities for graphic design, media production, and product distribution. In addition, EDC has offices worldwide. Located just outside of Boston, EDC has easy access to graduate student assistants and libraries at leading institutions of higher education.

A leader in science education, EDC's science projects range from instructional materials development to research studies to professional development. These projects are all grounded in the belief that understanding science is critical for leading an informed, productive life. Examples of two current projects are the analysis of how high school teachers use NSF-funded reform-based curricula and the synthesis of research that compares the impact of inquiry science on student outcomes to that of other instructional approaches.

EDC's installed base of \$2.5 million in computer and networking equipment is connected to a local area network (LAN). EDC uses CISCO routers to provide the latest in switched and virtual networking technology and support bandwidth-intensive network services. EDC's fully-staffed IT department supports network users via a help desk, full-time technical support staff, and a network administrator. EDC's full Internet-based applications and services provide access to databases including CHID, ACAD, and PsycInfo. A full line of software supports desktop publishing, statistical analysis, and database management. EDC also offers its staff a variety of collaboration tools—from secure file and document libraries to interactive teleconferencing. Given the growing number of Web sites we host at EDC we support a number of servers and a number of Web authoring tools. These include Dreamweaver, Visual Studio and Visual Interdev, Trellix, Frontpage, and Cold Fusion. EDC also uses the WebEx Webcast services, enabling participants in any location with Internet and phone access to participate in real-time meetings. EDC's technical team of programmers, and graphic designers assist with Web sites, database systems, and online communications.

EDC has a full range of support services including human resources, legal, communications, on-site building management, report production, and conference planning. EDC's accounting department provides cost accounting of project expenses, processing and payment of vendors' invoices, billing of customers, and maintenance of accounts receivable. The customer service department distributes more than 300 EDC products to targeted educational markets.

PARTNERS. To conduct this research and development program we will work with the following partners (see Appendix A for their letters of agreement). Action for Boston Community Development will participate in the pilot test. Self-Help, Inc., South Middlesex Opportunity Council, Communities United, Inc., and Montachusett Opportunity Council—all large and diverse Massachusetts Head Start grantees—will provide the pool of teachers for our sample. All five early childhood program partners serve children from low-income families, the majority of whom meet federal priority guidelines. The University of Massachusetts Amherst, a past collaborator, will provide the graduate and undergraduate credits for *Foundations*.

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- 7, 2003, from
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141. Pinker, S. (1997). *How the mind works*. New York: W. W. Norton & Co., Inc.
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146. Bryk, A. S., & Raudenbush, S. W. (1992). *Hierarchical linear models: Applications and data analysis methods*. Newbury Park, CA: Sage.
147. Collins, L. M., & Sayer, A. G. (2000). Modeling growth and change processes: Design, measurement, and analysis for research in social psychology. In H. Reis & C. Judd (Eds.), *Handbook of research methods in social psychology* (pp. 478-495). New York: Cambridge University Press.
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150. Patton, M. Q. (1990). *Qualitative evaluation and research methods* (2nd ed.). Newbury Park, CA: Sage.
151. Anderson, G. (1999). *Fundamentals of educational research*. Bristol, PA: Falmer Press.
152. Erlandson, D. A., Harris, E. L., Skipper, B. L., & Allen, S. D. (1993). *Doing naturalistic inquiry: A guide to methods*. Newbury Park, CA: Sage.

Program Director: Clark-Chiarelli, Nancy

Application Number: R305MA5060

**Curricula Vitae
Staff**

NANCY CLARK-CHIARELLI, EdD

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EDUCATION

Harvard University, Graduate School of Education, Cambridge, MA

Doctor of Education, 1994; Reading, Language, and Learning Disabilities

Master of Education, 1987; Reading and Language Program

University of Connecticut, Storrs, CT

Bachelor of Science, 1976, Summa Cum Laude; Major: Special Education

SELECTED RESEARCH AND DEVELOPMENT EXPERIENCE

Education Development Center, Inc., Newton, MA

Principal Investigator, *New England Research Center for Head Start Quality: The Next Generation* (2002–Present). Lead the development of a program-wide approach to help preschools make significant changes in supporting children's language and literacy development.

Principal Investigator, *Examining Impact of a Comprehensive Preschool Curriculum* (2004–Present). Design, conceptualize and oversee the implementation of a longitudinal study to examine a newly published curriculum's impact on teachers' practices and children's learning and school readiness, using a mixed methods design.

Principal Investigator, *Literacy Collaborative Classroom Instruction Impact Study* (2002–Present). Design and implement a longitudinal comparison group study comparing growth in quality of literacy instruction over time in classrooms implementing a framework for literacy instruction. Study examines the relationship between the level of fidelity of implementation of the framework and classroom quality.

Principal Investigator, *Evaluation of the Phonics Lessons: Letters, Words, and How They Work Curricular Resource* (2003–Present). Design and implement an impact study of a phonics curricular resource. The study is gathering data on first and second grade students' achievement in phonics, word identification, fluency, and comprehension and examining the impact of the resource on first and second grade teachers' literacy instructional practices.

Principal Investigator, *Examining Enduring Effects of High-Quality Curriculum* (2002–2004). Guide the development of tools to assess children's scientific understanding and the quality of science teaching. Designed and managed a pilot study to establish validity and reliability of classroom observation tool.

Principal Investigator, *Linking Assessment to Instruction: Tools for Better Teaching* (2002–2004). Play a lead role in developing, evaluating, and refining a set of tools that preschool teachers can use to assess the literacy development of individual children.

Project Director, *PBS TeacherLine Project* (2003–Present). Lead a team that is developing online reading and language arts professional development modules that will improve teacher practices and assure children receive high-quality literacy instruction. Topics include: how students become readers and writers; reading/language arts; and effective instructional strategies.

Senior Advisor, *Evaluation of the New Mexico Reading First Initiative* (2003–Present). Provide guidance regarding literacy issues including assessment, implementation, and pedagogy to an evaluation of New Mexico's statewide implementation of the Reading First program. The

evaluation is examining student impact quantitatively through student achievement and assessment data, Special Education referral, and English Language Learner exit rates.

Technical Adviser, *PBS Parents Web Site: Talking and Reading Together* (2001–Present).

Led the development of and oversee a major region on the PBS Parents Web site that helps parents promote the language and literacy development of children ages 0–8.

Co-Principal Investigator, *Using Technology to Support Preschool Teachers' Professional Development* (1999–2002). Integrated distance learning technologies into a literacy-focused professional development model. Using a control group design, examined the model's impact on teachers' and supervisors' beliefs and practices and on children's literacy growth.

Senior Methodologist, *New England Research Center for Head Start Quality* (1999–2001).

Used multilevel models to investigate the impact of varied aspects of classroom quality on the literacy and social development of 400 children from diverse language backgrounds.

Harvard Pilgrim Health Care—Teaching Programs, Boston, MA

Clinical Instructor and Senior Research Associate, *Harvard Medical School* (1994–1998).

Co-investigator, methodologist, and senior analyst for The Robert Wood Johnson Foundation-funded *Attitudes and Choices in Medical Education and Training* project.

The Walker Home and School, Needham, MA

Research Associate (1994–2000). Designed long-range research study to document the academic, social, and psychological growth of children with emotional disorders.

Statistical Analysis Specialist (1989–Present). Conduct statistical analyses using SAS, SPSS, SUDAAN, WESSTAT, and HLM for research projects focusing on education, health, and developmental psychology. Clients have included Harvard School of Public Health, Earthwatch, Inc., Center for Research on Women at Wellesley College, and Children's Hospital.

TEACHING EXPERIENCE

1994–Present: Wheelock College, Graduate School Faculty

1993–1995: Simmons College, Graduate School Lecturer

1991–1995: Lesley College, Senior Lecturer

SELECTED PRESENTATIONS AND PUBLICATIONS

Clark-Chiarelli, N., Dickinson, D.K., Bolte, G., & Buteau, E. (2004, June). *A systematic approach to fostering language and literacy development through professional development*. Presented at the Head Start Research Conference, Washington, DC.

Clark-Chiarelli, N., Dickinson, D.K., Peisner-Feinberg, E., & Buteau, E. (2004, June). *Teaching and learning in preschool classrooms: Findings from the Technology-enhanced Language Environment Enrichment Program*. Presented at the Head Start Research Conference, Washington, DC.

Clark-Chiarelli, N., Buteau, E., & Anastasopoulos, L. (2004, April). *Early childhood curriculum and teacher practice*. Presented at the American Educational Research Association Annual Meeting, San Diego, CA.

Dickinson, D. K., McCabe, A., & Clark-Chiarelli, N. (2004). Preschool-based prevention of reading disability: Realities versus possibilities. In C. A. Stone & E. Silliman (Eds.), *Handbook of reading disabilities*. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Dickinson, D. K., McCabe, A., Clark-Chiarelli, N., & Wolf, A. (in press). Cross-language transfer of phonological awareness in low-income Spanish and English bilingual preschool

- children. *Applied Psycholinguistics*.
- Connelly, M. T., Sullivan, A. M., Peters, A. S., Clark-Chiarelli, N., Zotov, N., Martin, N., Simon, S. R., Singer, J. D., & Block, S. D. (2003). Variation in predictors of primary care career choices by year and stage of training: A national survey. *Journal of General Internal Medicine*, 18(3), 159–169.
- Clark-Chiarelli, N., Dickinson, D., Peisner-Feinberg, E., Anastasopoulos, L., Caswell, L., Sprague, K., Kraemer-Cook, B., & Sayer, A. (2002, November). *The impact of the Technology Enhanced Language Environment Enrichment Program (T-LEEP)*. Paper presented at the Interagency Education Research Initiative Principal Investigator Conference, Alexandria, VA.
- Clark-Chiarelli, N., Kraemer-Cook, B., Smith, M., & McCabe, A. (2002). *Talking and reading together*. Retrieved March 9, 2002, from the PBS Parents Web site, <http://www.pbs.org/parents/issuesadvice/talkingandreading>.
- Dickinson, D. K., Sprague, K., Sayer, A., Miller, C., & Clark-Chiarelli, N. (2001, April). *A multilevel analysis of the effects of early home and preschool environments on children's language and early literacy development*. Paper presented at the annual conference of the American Educational Research Association, Seattle, WA.
- Morocco, C. C., Hindin, A., Aguilar, C. M., & Clark-Chiarelli, N. (Winter, 2001). Building a deep understanding of literature with middle-grade students with learning disabilities. *Learning Disabilities Quarterly* 24, 47–58.
- Dickinson, D. K., Sprague, K., Sayer, A., Miller, C., Clark-Chiarelli, N., & Wolf, A. (2000, June). Classroom factors that foster literacy and social development of children from different language backgrounds. In M. Hopmann (Chair), *Dimensions of program quality that foster child development: Reports from 5 years of the Head Start Quality Research Centers*. Poster symposium presented at the 5th National Head Start Research Conference, Washington, DC.
- Pan, R. J., Clark-Chiarelli, N., Peters, A. S., & Block, S. D. (1999). Intention to practice primary care by pediatric residents: Nature or nurture? *Clinical Pediatrics*, 473–479.
- Peters, A., Clark-Chiarelli, N., & Block, S. (1999). Comparison of osteopathic and allopathic medical schools' support for primary care. *Journal of General Internal Medicine*, 14, 730–739.
- Peters, A., Clark-Chiarelli, N., & Block, S. (1999). Perspectives on teaching among community-based family physicians. *Teaching and Learning in Medicine*, 11, 244–248.
- Simon, S., Pan, R., Sullivan, A. M., Clark-Chiarelli, N., Connelly, M. T., Peters, A. S., Singer, J. D., Inui, T. S., & Block, S. D. (1999). Views of managed care—a survey of students, residents, faculty, and deans at medical schools in the United States. *The New England Journal of Medicine*, 340, 928–936.
- Block, S., Clark-Chiarelli, N., & Singer, J. (1998). Mixed messages about primary care and the culture of U.S. medical schools. *Academic Medicine*, 73, 1087–1094.
- Zinn, W., Block, S. D., & Clark-Chiarelli, N. (1998). Enthusiasm for primary care: A comparison of family medicine and general internal medicine. *Journal of General Internal Medicine*, 13, 186–194.
- Block, S., Clark-Chiarelli, N., Peters, A., & Singer, J. (1996). Academia's chilly climate for primary care. *Journal of the American Medical Association*, 276, 687–682.
- Clark-Chiarelli, N., & Singer, J. D. (1995). Teachers of students with emotional and behavioral disorders: Who they are and how they view their jobs. In J. M. Kauffman, J. W. Lloyd, T. A. Astuto, & D. P. Hallahan (Eds.), *Issues in the educational placement of pupils with emotional or behavioral disorders*. Hillsdale, NJ: Erlbaum.

JESS GROPEN, Ph.D.

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EDUCATION

- Ph.D.** 1989, **Massachusetts Institute of Technology**
Boston, Massachusetts. Cognitive Science. Advisor: Dr. Steven Pinker
- B.A.** 1982, **Pomona College**, cum laude.
Claremont, California. Language and Mind

SELECTED RESEARCH AND ACADEMIC EXPERIENCE

Education Development Center, Inc., Newton, MA

Senior Research Associate, *New England Quality Research Center for Head Start* (2004–Present). Oversee large-scale quantitative and qualitative research on a program-wide approach to help preschools make and sustain significant changes in supporting children's language and literacy. Coordinate collection of teacher, child, and parent data. Conduct descriptive, regression, and HLM analyses. Take lead in developing a toolkit for analyzing conversation in the pre-school environment. Write progress reports and continuation proposals. Prepare presentations for in-house and national audiences. Areas of expertise include research and statistical methods, cognitive science, cognitive development, and language acquisition.

Senior Research Associate, *Literacy Collaborative Classroom Instruction Impact Study* (2004–Present). Design and conduct longitudinal HLM analyses on the growth in quality of literacy instruction over time in classrooms implementing a framework for literacy instruction. Study examines the relationship between the level of fidelity of implementation of the framework and classroom quality.

Senior Research Associate, *Evaluation of the Phonics Lessons: Letters, Words, and How They Work Curricular Resource* (2004–Present). Design and conduct HLM analyses on a phonics curriculum. The study gathers data on first and second grade students' achievement in phonics, word identification, fluency, and comprehension, and examines the impact of the resource on first and second grade teachers' literacy instructional practices.

Simmons College, Boston, MA

Assistant Professor, *Psychology* (2003–2004). Taught courses in introductory psychology, research methods, perception, cognition, research in cognitive processes. Conducted research on the linguistic expression of emotion.

Lecturer (2002–2003). Taught courses in research methods, perception, and cognition.

McGill University, Montreal, Canada

Assistant Professor, *Psychology* (1991–2000). Taught undergraduate courses in research methods, cognition, and psychology of language, and a graduate seminar on the mental lexicon. Chaired the Psychology Department Human Subjects IRB (1994–1997), and served on the Psychology Executive Committee (1994–1995).

Director, Laboratory for Language and Memory (1991–2000). Managed a research lab, with a total of 25 undergraduate students over eight years. Conducted research in cognitive science, with a focus on language acquisition, language processing, and lexical semantics; obtained research grants from U.S. and Canadian national agencies; published results in leading journals, including *Cognition* and *Language*.

Stanford University, Stanford, CA

Postdoctoral Scholar, Linguistics (1989–1991). Taught a seminar on the acquisition of verb argument structure. Conducted research in cognitive science, with a focus on language universals. Conducted an analysis of verb argument structure in Russian and other languages.

Liquid Grammar, Sharon, MA

Partner (2001–2004). Began development of a semantic interlingua, based on research in lexical semantics and the WordNet Ontology. Began development of a complementary system for input disambiguation, including automatic verb sense identification.

WordStream, Inc., Somerville, MA

Manager, User Interaction and Grammar Research (2000–2001). Lead a team of five linguists in the rapid development of a grammar for the translation of sports news alerts from English into French, German, Japanese, Mandarin, and Spanish. Experience includes the successful broadcast of sports news alerts from the Sydney Olympic Games. Developed and documented the user-interaction system at WordStream, based on an analysis of computer-human interaction in human-aided machine translation.

SELECTED DEVELOPMENT AND CONSULTING EXPERIENCE

Final Word Consulting, Sharon, MA

Principal (2001–2004). Provided educational and other local non-profit organizations with a broad range of services, including strategic planning, development, and program evaluation. Clients have included University of Massachusetts-Boston, Northeastern University, TechBoston, MassPEP, Machine Science, and Tufts-New England Medical Center. Projects supported include Reach Out and Read at the Tufts-NEMC Floating Hospital, and Boston Area Advanced Technological Education Connections (BATEC) at University of Massachusetts-Boston. A total of more than \$4 million was raised from foundations, federal agencies, and private investors.

SUMMARY OF TRANSFERABLE SKILLS

- *Research and Program Evaluation:* obtaining and reviewing available information; formulating hypotheses, models, and strategies; designing appropriate research methods; collecting and analyzing data.
- *Management:* leading multidisciplinary teams of specialists; managing research laboratories staffed by trainees; overseeing multiple individual projects; serving as the chair of administrative committees.
- *Training:* leading seminars; teaching courses; supervising individual trainees; using instructional technology; creating portfolios; designing curricula.
- *Communication:* writing research reports, grant proposals, professional correspondence, web page copy, and creative material; preparing and delivering presentations to diverse audiences.

- *Computer*: programming (C, Perl, XML, HTML); operating systems (Windows, Mac OS, Unix); statistical packages (SPSS, Statview, HLM); experimental control software (PsyScope, Pxlabs).

SELECTED PRESENTATIONS AND PUBLICATIONS

- Clark-Chiarelli, N., Gropen, J., and Bolte, G. (2004, September). *Analysis of four waves of classroom data*. Presented at the Head Start Quality Research Center Consortium Meeting, Washington, DC.
- Gropen, J. (2000) Methods for studying the production of argument structure in children and adults. In L. Menn & N. Bernstein Ratner (eds.), *Methods for studying language production*. Lawrence Erlbaum Associates, Inc.
- Gropen, J., Epstein, T., and Schumacher, L. (1997). Context-sensitive verb learning: Children's ability to associate contextual information with the argument of a verb. *Cognitive Linguistics* v. 8:2, 137-182.
- Gropen, J., Blaskovich, J., and DeDe, G. (1996). "Come it closer": Causative errors in child speech. In A. Stringfellow, D. Cahana-Amitay, E. Hughes, and A. Zukowski (eds.), *Proceedings of the Twentieth Annual Boston University Conference on Language Development, Vol. 1*, 272-283. Somerville, MA: Cascadilla Press.
- Gropen, J. (1995). A neural net model of argument structure. *McGill Papers in Cognitive Science*. Technical Report No. 2395. McGill University, Montreal, Canada.
- Gropen, J., Pinker, S., Hollander, M., and Goldberg, R. (1991). Affectedness and direct objects: The role of lexical semantics in the acquisition of verb argument structure. *Cognition*, 41, 153-195.
- Gropen, J., Pinker, S., Hollander, M., and Goldberg, R. (1991). Syntax and semantics in the acquisition of locative verbs. *Journal of Child Language*, 18, 115-151.
- Gropen, J., Pinker, S., Hollander, M., and Goldberg, R. (1990). Object affectedness and the acquisition of novel verbs. *Papers & Reports on Child Language Development*, 29, 62-69.
- Gropen, J. (1990). Bootstrapping from agency: Early notions of agency according to Pinker's Semantic Bootstrapping Hypothesis. *Papers & Reports on Child Language Development*, 29, 148-155.
- Gropen, J., Pinker, S., Hollander, M., Goldberg, R., and Wilson, R. (1989). The learnability and acquisition of the dative alternation in English. *Language*, 65, 203-257.

SELECTED RESEARCH GRANTS

Natural Sciences and Engineering Research Council of Canada

The Acquisition and Processing of Verb Syntax, 1997–2000

The Acquisition of Verb Polysemy, 1992–1995

Workstation for the Analysis of Computerized Speech Corpora and Dictionary Databases, 1993

National Institute of Child Health and Human Development

Universal Linking Rules in Verb Learning, 1989–1991

MIRIAM W. SMITH

(b)(6)

EDUCATION

Clark University, Worcester, MA

EdD, Education, May, 1996. Coursework and concentration in language and literacy development, discourse analysis, socio-cultural perspectives, cognitive development, teacher-research. **Dissertation:** *Teacher-Child Interaction in Early Childhood Classrooms: Theoretical and Practical Perspectives.*

Tufts University, Eliot-Pearson Department of Child Study, Medford, MA

MA, Applied Child Development, February, 1990. Coursework in cognitive development, language development, social policy, curriculum and classroom design, research methods, statistics. **Thesis:** *Dimensions of Variation in Preschool Teachers' Discourse*

Bates College, Lewiston, ME

BA in Psychology, 1985

AWARDS:

- **Head Start Graduate Research Fellow, October 1993–September 1994.** One year fellowship for dissertation research on discourse and curriculum development in Head Start classrooms.
- **Spencer Fellow, September 1992–September 1993.** One year fellowship for dissertation research on teacher-child discourse in Head Start classrooms.
- **Head Start Graduate Research Fellow, September 1991–September 1992.** One year fellowship for research related to curricular features of Head Start classrooms.

SELECTED PROFESSIONAL ACTIVITIES

Education Development Center, Inc. Newton, MA (1995–Present)

Curriculum Content Developer, PBS Teacherline Course Development (November 2003–Present). Developed a rigorous course designed for online delivery through PBS Teacherline. The focus of this course was children's vocabulary development in the middle elementary grades.

Curriculum Content Developer, EDC/PBS Parents Website Development (April 2001–September 2001). Developed the concept and content for PBS Parents website focused on children's early language and literacy development. Worked with team members and web site developers to create an informative, interactive site.

Curriculum Content Developer, Excellence in Teaching (October 2000–March 2001). Developed two courses—one on classroom ecology and strategies for addressing challenging behaviors and one focused on incorporating language and literacy throughout the classroom—designed to support early childhood teachers' professional development.

Project Director, National Board for Professional Teaching Standards Renewal Survey (January–April 1998). This project addressed issues relevant to the 10-year mandatory renewal of National Board Certified teachers' initial certification. Goals were to design, implement, and analyze a survey of all 912 National Board Certified Teachers. Convened and facilitated focus groups and guided the development of a traditional and online survey instrument, analyzed data, and prepared final report.

Principal Investigator, Early Language and Literacy Classroom Observation (August 1997–July 1998). Lead author of two books produced by the project, *Early Language and Literacy*

Classroom Observation Toolkit and User's Guide to the Early Language and Literacy Classroom Observation Toolkit. Led the development, pilot-testing, and revision of observation tools—one suited to preschool and kindergarten classrooms and one designed for Grades 1–3—for evaluating language and literacy opportunities in classrooms. Pilot-tested the preschool version in 50 classrooms as part of the New England Quality Research Center on Head Start.

Co-Principal Investigator, *Enriching Language Environments Together* (September 1997–July 1998). Led this multi-year, collaborative project with Communities United in Waltham, MA. Guided a small group of Head Start teachers in thinking regularly and critically about the role of language and literacy experiences in their classrooms. An outcome of previous research, this collaborative intervention project was designed to benefit the long-term academic success of young children and the professional development of Head Start staff.

Research Associate, *INTASC Test of Teaching Knowledge Project* (January–August 1997). Advanced the joint efforts of EDC and Educational Testing Service to develop a comprehensive test—commissioned by INTASC and the Council of Chief State School Officers—to assure the preparedness of new teachers. The test was designed to be used as part of a portfolio approach to the licensing of new teachers. Was responsible for generating items for the various forms of the test, assisting with pilot testing, and developing scoring criteria and procedures.

Research Associate, *Early Childhood Assessment Development Laboratory* (1994–1996). Worked on the development, scoring scheme, pilot testing, and scoring of performance-based assessments, including the design and scoring of performance tasks focusing on early childhood mathematics, science, and designing integrated curriculum.

Harvard Graduate School of Education

Research Associate (September 1989–1999). Worked with Drs. Catherine Snow and David Dickinson on the Home-School Study of Language and Literacy Development. Transcribed, coded, and analyzed data from preschool classrooms.

RESEARCH ON SCIENCE TEACHING AND LEARNING

Jacob Hiatt Center and Goddard School of Science and Technology

Researcher (September 1992–June 1994). Continued and expanded collaborative teacher-research project on "Science Talk" with elementary and early childhood students.

Clark University and Freeland Street School

Researcher (September 1991–June 1992). Participated in a newly developed teacher-researcher program between Clark University and the Worcester Public Schools. In cooperation with a Primary Resource Room teacher, recorded, transcribed, analyzed, and presented data on children's acquisition of science concepts and scientific discourse.

Participant, Goddard Preschool Project (September 1992–June, 1994). Member of an interdisciplinary planning team which designed and wrote several grants to support the implementation of a laboratory preschool in the Goddard School of Science and Technology.

Research Assistant (September 1989–June 1990). Helped develop and implement a year-long ethnographic investigation of a unique undergraduate Physics course. Videotaped, transcribed, and analyzed student interactions and science concept learning.

SELECTED PUBLICATIONS AND PRESENTATIONS

- Smith, M. W., & Dickinson, D. K., with Sangeorge, A., & Anastasopoulos, L. (2002). Early Language and Literacy Classroom Observation (ELLCO) Toolkit. Baltimore, MD: Brookes.
- Smith, M. W., & Dickinson, D. K., with Sangeorge, A., & Anastasopoulos, L. (2002). User's guide to the Early Language and Literacy Classroom Observation (ELLCO) Toolkit. Research edition. Baltimore, MD: Brookes.
- Smith, M. W. (2001). School Experiences of Children. Chapter published in: Dickinson, D. K. & Tabors, P.O. Beginning Literacy with Language. Baltimore, MD: Brookes.
- Dickinson, D., Snow, C., Roach, K., Smith, M., & Tabors, P. (April, 1998). Home and preschool factors affecting language and literacy development in kindergarten. Presentation at the annual meetings of the Society for the Scientific Study of Reading, San Diego, CA.
- Smith, M. W., & Dickinson, D. K. (November, 1997). The ELLCO and TCVI: Two instruments for looking at interaction in early childhood classrooms. Presentation given at the Annual Conference of the National Association for the Education of Young Children, Anaheim, CA.
- Smith, M. W., Haine, R. A., & Dickinson, D. K. (April, 1997). Teachers' assessments of children's literacy. Paper presented at the Biennial Meetings of the Society for Research in Child Development, Washington, DC.
- Smith, M.W. (December, 1996). What, where, when, & how: Interaction in preschool classrooms. Paper presented at the Annual Meetings of the National Reading Conference, Charleston, SC, December 4-8, 1996.
- Dickinson, D. K., & Smith, M. W. (April 1994). Connections among preschool teachers' beliefs and practices and the early academic outcomes of low income children. Presentation at the Annual Meetings of the American Educational Research Association, New Orleans, LA.
- Dickinson, D.K. & Smith, M. W. (1994). Long-term effects of preschool teachers' book readings on low-income children's vocabulary and story understanding. Reading Research Quarterly, 29 (2), pp. 105-122.
- Smith, M. W. & Dickinson, D.K. (1994). Describing oral language opportunities and environments in Head Start and other preschool classrooms. Early Childhood Research Quarterly, 9 (3&4), 345-366.
- Smith, M. W. (November 1993). Connections, Communities, and Change. Presentation at the Annual Conference of the American Anthropological Association, Washington, DC.
- Smith, M. W. (February, 1993). Discovering Physics as a context for alternative assessment. Presentation for the Citizen's Educational Resource Center, Worcester, MA.
- Smith, M. W., & Guerra, M. (June, 1993). Doing "Science Talk" with very young children. Presentation at the Fifth Annual Conference on Ethnographic and Qualitative Research in Education, Amherst, MA.
- Dickinson, D. K., Cote, L., & Smith, M. W. (April, 1993). Classrooms as lexical environments. Symposium conducted at American Educational Research Association Meeting, Atlanta, GA.
- Dickinson, D.K., Cote, L.R. & Smith, M. W. (1993). Learning vocabulary in preschool: Social and discourse contexts affecting vocabulary growth. In C. Daiute (Ed.), The Development of Literacy Through Social Interaction. In W. Damon (Ed.), New Directions in Child Development Series, Number 61. San Francisco, CA: Jossey-Bass Publishers.
- Guerra, M., & Smith, M. W. (1992). "Science is wonderful": Evolving scientific discourse in a Primary Resource Room classroom. The Literacies Institute Annual Newsletter.

COSTANZA EGGERS-PIÉROLA
Education Development Center, Inc.
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EDUCATION

Harvard University, Cambridge, MA

EdD, June, 1996. **Specialization:** Qualitative research on equity and learning issues for bilingual and minority populations. **Doctoral Thesis:** *"We haven't still explored that": Science learning in a bilingual classroom.*

EdM in International Education, June, 1990. **Specialization:** Multicultural education and educational reform, planning, and programming in international settings.

HONORS

- Recipient of the Schott Fellowship for Early Care and Education from the Schott Center for Public and Early Education, 2004.
- Recipient of an American Educational Research Association/Spencer Doctoral Research Fellowship, 1995–96.

SELECTED RESEARCH AND DEVELOPMENT EXPERIENCE

EDUCATION DEVELOPMENT CENTER, NEWTON, MA—Senior Associate for Research and Development (2000–Present). Lead an initiative to support the career advancement of Latinos in the early childhood education field. Led the work of a consortium of national organizations in identifying key issues in culturally and linguistically responsive professional development for Latinos. Produced "Connections and Commitments: A Latino-based Framework for Early Childhood Educators", a web-based framework that includes research and best practices for working with Latino children and families, and a list of resources and tools in Spanish and English. Developed a book of activities and tools based on the framework to be published by Heinemann in Spring of 2005.

CHILD CARE CAREERS INSTITUTE AND THE MASSACHUSETTS DEPARTMENT OF EDUCATION—Researcher and Consultant (October 1998–2002). Designed culturally and linguistically relevant materials and training for bilingual or Spanish-dominant early childhood teachers. Developed qualitative and quantitative instruments for the formative evaluation of a state-sponsored program for the advancement of early childhood educators. Collaborated with staff to design, pilot, and revise a tool for 12 programs in institutions of higher learning and local agencies. Explored program alternatives for recruiting and supporting diverse professionals in the field and implementing programmatic and degree articulation reforms to respond to the needs of the field. Analyzed, presented, and published preliminary findings.

BOSTON ANNENBERG CHALLENGE, BOSTON, MA—Consultant (September 1998–July 2000). Served as a reform and content coach for a citywide initiative based on the new State Standards and the Boston Plan for Excellence. Supported the reform and implementation of curriculum, accountability, and assessment in a large bilingual city school. Identified needs relevant to work with Latino children and families. Wrote and adapted materials and trainings specifically for bilingual teachers, children, and families. Assessed school-based needs and designed professional development, assessments, and structural supports to align school improvement with the State Standards. Provided training for teachers in best practices for bilingual literacy. Compiled and analyzed data to inform district interventions.

RYERSON POLYTECHNIC INSTITUTE, TORONTO, CANADA—*Co-Principal Investigator (1996–2000)*. Led a long-range, cross-national project that studied alternative models of child care to serve diverse populations. Studied the impact of multi-age groupings on early childhood development, policies, and teacher training. Managed operations, developed instruments, conducted research, analyzed data, and presented and published findings.

INVERNESS RESEARCH ASSOCIATES, INVERNESS, CA—*Research Consultant (1994–1998)*. Conducted formative evaluation and consulted with the New York State Systemic Initiative, a statewide reform effort focused on science, math, and technology. Contributed to research design, evaluation, and data analysis. Conducted and documented site visits, interviewed administrators, teachers, and other key stakeholders, and facilitated communication between the state and the schools. Presented and published monographs on the New York State reform and the alignment with State and National Standards.

WHEELOCK COLLEGE, BOSTON, MA—*Instructor (1995–1998)*. Member of the Graduate School teaching faculty. Developed and taught courses for graduate and undergraduate level education classes. Advised on the Standards-based Early Care and Education Program Portfolio process and criteria. Supervised and advised student teachers, and designed and led practicum seminars. Courses included *Sociology of Bilingual Education*, *Multicultural Perspectives on the Family*, and seminars for student teachers.

HARVARD UNIVERSITY, GRADUATE SCHOOL OF EDUCATION, CAMBRIDGE, MA—*Researcher (1992–1995)*. Served as co-investigator and writer for a study on the childrearing beliefs of low-income mothers and the effects of their beliefs on their experiences with the child care and education system. Developed frameworks and theories for integrating cultural and linguistic beliefs and practices relevant to Latinas. Contributed to research design, implementation, data analysis, and presentation and publication of findings.

TERC, CAMBRIDGE, MA—*Research Associate (1992–1994)*. Participated in an long-term action research project focusing on bilingual teachers' and students' scientific teaching and learning. Planned, implemented, and analyzed student interviews, classroom observations, and teacher seminars. Videotaped, organized, and analyzed observations in three Spanish bilingual classrooms for two years. Provided technical assistance, collaborated with the teachers, and presented reports of the findings. Contributed to the research team's publication efforts and proposal writing. Developed discourse analysis and curriculum implications based on the two-year intervention.

SELECTED PUBLICATIONS AND PRESENTATIONS

Eggers-Piérola, C. (in press). *Connections and Commitments: Working with Latino children and families*. [tentative title]. Portsmouth, NH: Heinemann.

Eggers-Piérola, C. (2002). *Connections and Commitments: A Latino-based framework for early childhood educators*. Newton, MA: Education Development Center, Inc.

Eggers-Piérola, C. (2002, April). *Connections and commitments: A Latino-based framework for early childhood educators' work with families and children*. Expert testimony at the Commission Hearing of the White House Initiative on Educational Excellence for Hispanic Americans, Las Vegas, NV.

Eggers-Piérola, C. (2001). *Orientation guide for Spanish-speaking teachers: Supervisor manual*. Boston, MA: Child Care Careers Institute.

- Bernhard, J., Pollard, J., Eggers-Piérola, C. & Morin, A. (2000). Infants and toddlers in Canadian multi-age, childcare settings: Age, ability, and linguistic inclusion. *Research Connections Canada*. Ottawa, ON: Canadian Child Care Federation, Vol. IV, pp.79-185.
- St. John, M., Century, J., Eggers-Piérola, C., Houghton, N., Jennings, S. & Tibbitts, F. (1999). *The principles of educational reform: Supporting mathematics and science teaching in your school. A handbook for elementary and middle school principals*. Inverness, CA: Inverness Research Associates.
- Fuller, B., Holloway, S., Rambaud, M. & Eggers-Piérola, C. (1998). How do low-income mothers "choose" child care? Alternative models in poor neighborhoods. *Sociology of Education*.
- Bernhard, J. K., Gonzalez-Mena, J., Chang, H. N., O'Loughlin, M., Eggers-Piérola, C., Roberts Fiati, G., & Corson, P. (1998). Recognizing the Centrality of Cultural Diversity and Racial Equity: Beginning a Discussion and Critical Reflection on "Developmentally Appropriate Practice". *Canadian Journal of Research in Early Childhood Education*, 7(1), 81-90.
- Holloway, S., Fuller, B., Rambaud, M. & Eggers-Piérola, C. (1997). *Through my own eyes: Single mothers and the cultures of poverty*. Cambridge: Harvard University Press.
- Eggers-Piérola, C (1996, December). *Un diálogo crítico en una clase de ciencias*. Paper presented at the III International Congress on Educational Research, Universidad Autónoma de Tamaulipas, Ciudad Victoria, Tamaulipas, México.
- Holloway, S., Rambaud, M. Fuller, B., & Eggers-Piérola, C. (1996). What is "appropriate practice" at home and in child care? Low-income mothers' views on preparing their children for school. *Early Childhood Research Quarterly*, 10, 451-473.
- Fuller, B., Eggers-Piérola, C., Holloway, S., Liang, X., & Rambaud, M (1996). Rich cultures, poor markets: Why do Latino parents choose to forego pre-schooling? *Teachers College Record*, 97, 3, 400-418.
- Eggers-Piérola, C. & Irizarry, H. (1995, April). *"We haven't still explored that": A critical practice in a bilingual science class*. Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA.
- Eggers-Piérola, C. (1994, July). *"Todavía no lo hemos explorado": Una práctica crítica en un aula bilingüe de ciencias*. Paper presented at the International Congress on New Critical Perspectives in Education, University of Barcelona, Barcelona, Spain.
- Holloway, S., Fuller, B., Rambaud, M. & Eggers-Piérola, C. (1994, April). *What is appropriate practice? Views of low-income mothers*. Paper presented at the Annual Meeting of the American Research Association, New Orleans.
- Eggers-Piérola, C. & Rodríguez, Y. (2001, November) *El desarrollo de maestros y niños latinos en ambientes bilingües e interculturales: The development of Latino early childhood teachers and children*. Presentation at the Annual Conference of the National Association for the Education of Young Children, Anaheim, CA.
- Eggers-Piérola, C, Fortney, J., & Du Maresq, M. (1998, November). *Multi-age groupings in early childhood education: teacher perceptions and diversity issues*. Presentation at the Annual Conference of the National Association for the Education of Young Children, Toronto, Canada.
- Holloway, S, Fuller, B., Rambaud, M., & Eggers-Piérola, C. (1994). *What is appropriate practice? Low income mothers' views on education*. Paper presented at the Fifteenth Annual Ethnography in Education Forum, University of Pennsylvania, Philadelphia, PA.

LANGUAGES: Native Spanish speaker, proficient and fluent in English and French

INGRID H. CHALUFOUR

(b)(6)
(b)(6) ay) (b)(6) evening); e-mail: ichalufour@edc.org

EDUCATION

1983 MEd, University of Maine, Orono, ME (in 1984 named to Phi Kappa Phi Honor Society)
1967 BS, Early Childhood Education, Wheelock College, Boston, MA

RESEARCH AND DEVELOPMENT EXPERIENCE

Education Development Center, Inc., Newton, MA

Senior Research Associate, *Project STARS* (2001–Present). Contribute to the design and implementation of a multi-year statewide initiative to improve the literacy learning and promote the school readiness of at-risk preschool children. In the first phase of the initiative, contributed to the design of performance-based assignments and a grading system to evaluate teachers' and supervisors' learning and application of concepts. Contribute to the development of a mentor training component and related materials and oversee its implementation. Serve as a course instructor.

Project Director, *Linking Assessment to Instruction: Tools for Better Teaching* (2003–2004).

Pilot-test and develop trainings for a set of tools that preschool teachers can use to assess the literacy development of individual children. The tools provide teachers with clear-cut information about the range of knowledge essential for children's early literacy development.

Project Director, *Examining Enduring Effects of High-Quality Curriculum* (2002–2004).

Assume a lead role in developing, testing, and revising a tool to assess the quality of science teaching. The tool will be used to examine the effects of the *Young Scientist Series*.

Senior Professional Development Specialist, *Center for Children & Families* (1999–Present).

Responsible for the development and delivery of the credit-bearing *Excellence in Teaching (EIT)* professional development program for early childhood teachers and supervisors. Take the lead in designing performance tasks that assess teachers' and supervisors' understanding and application of key concepts. Serve as course instructor, and work with higher education institutions to develop and oversee procedures for projects to offer courses for college credit. Developed EIT's supervisor component—observation and conferencing to support teacher implementation of new teaching practices. Developed and taught on-line course in curriculum in collaboration with Lesley College. Oversee revision of literacy course for on-line delivery and instruct for Milwaukee Early Reading First Project.

Senior Professional Development Specialist, *Head Start Mentor-Coach Instructional Design* (2003–2004).

Contribute to the development of a four-unit multimedia training package for Head Start mentor-coaches nationwide. The instructional design—a blend of tutored video instruction, Web-based learning, and face-to-face interaction—will prepare mentor-coaches to guide Head Start teachers in adopting research-based practices that foster young children's language and literacy development.

Co-Principal Investigator, *Toolkit for Early Childhood Science Education* (1999–2003).

Responsible for the development of the *Young Scientist Series*, a comprehensive curriculum

designed to improve science teaching and learning in early childhood programs across the country. Funded by the National Science Foundation, the *Young Scientist Series* includes three curriculum units and accompanying multi-media professional development materials. The first unit, *Discovering Nature with Young Children*, was published by Redleaf Press in 2003, and units on water and building structures will be published in 2004 and 2005.

Education Specialist (1990–1994). Provided training and technical assistance on Head Start and early childhood topics for Head Start teachers, administrators, and parents in the New England Region. Emphasized work with managers on their role in building program quality. Topics included supervision, child assessment, curriculum, multicultural programming, and National Association for the Education of Young Children accreditation.

Associated Day Care Services, Boston, MA

Director, Educational Training (1987–1990). Oversaw professional development of teaching staff in nine inner-city day care programs. Provided technical assistance to program directors on quality issues.

Actions Opportunities, Inc., Ellsworth, ME

Project Director/Curriculum Developer (1985–1987). Developed a mental health curriculum for Head Start (*AS I AM*) that continues to be distributed nationally.

Consultation for Maine Department of Education (1985–1986). Managed a grant to develop and pilot-test a parenting curriculum (*Like Parent, Like Child*) for Maine Department of Education.

VOLUNTEER PROFESSIONAL WORK

2003–Present: Contribute to the National Association for the Education of Young Children's reinvention of its accreditation system. As a member of the Teaching Technical Resource Team, develop draft accreditation performance criteria for new teaching program standards.

2004–Present: Member of National Association for the Education of Young Children Advisor Network on Improving Early Childhood Professional Practice.

SELECTED PRESENTATIONS AND PUBLICATIONS

Chalufour, I., & Moriarty, R. (November, 2004). *The Role of Representation in Science and Literacy Learning*. Presentation at the National Association for the Education of Young Children's Annual Conference, Anaheim, CA.

Chalufour, I., & Brady, J. P. (2004, June). *Performance assessment through assignments in credit-bearing professional development*. Presentation at the National Association for the Education of Young Children's Institute for Early Childhood Professional Development, Baltimore, MD.

Chalufour, I., & Worth, K. (2004, June). *Using observation to assess and support science teaching*. Presentation at the National Association for the Education of Young Children's Institute for Early Childhood Professional Development, Baltimore, MD.

Chalufour, I. (2004, March) *Discovering Nature with Young Children*. Presentation at the Core Knowledge Foundation Conference, Atlanta, GA.

- Chalufour, I., Worth, K., Moriarty, R., Winokur, J., & Grollman, S. (forthcoming). *The Young Scientist Series: Exploring water with young children (teacher's guide and trainer's guide and video)*. St. Paul, MN: Redleaf Press.
- Chalufour, I., Worth, K., Moriarty, R., Winokur, J., & Grollman, S. (2004). *The Young Scientist Series: Building structures with young children (teacher's guide and trainer's guide and video)*. St. Paul, MN: Redleaf Press.
- Chalufour, I., Hoisington, C., Moriarty, R., Winokur, J., & Worth, K. (2004, January). The science and mathematics of building structures. *Science and Children*, 41(4), 30–34.
- Chalufour, I., Worth, K., Moriarty, R., Winokur, J., & Grollman, S. (2003). *The Young Scientist Series: Discovering nature with young children (teacher's guide and trainer's guide and video)*. St. Paul, MN: Redleaf Press.
- Chalufour, I., Worth, K., & Winokur, J. (2003, November). *The role of literacy in enhancing science understanding*. Presentation at the National Association for the Education of Young Children Annual Conference, Chicago, IL.
- Chalufour, I., Winokur, J., & Moriarty, R. (2003, November). *Science and play: What teachers do to encourage science inquiry*. Presentation at the National Association for the Education of Young Children Annual Conference, Chicago, IL.
- Dickinson, D. K., Caswell, L., & Chalufour, I. (2003, June). *Creating classrooms that foster literacy in preschool classrooms through an in-service intervention*. Presentation at Piaget Society, Chicago, IL.
- Worth, K., & Chalufour, I. (2002, June). *Understanding children's science learning: The role of documentation*. Presentation at the National Association for the Education of Young Children Professional Development Institute, Albuquerque, NM.
- Chalufour, I., & Worth, K. (2001, June). *Science explorations for young children: An approach to teacher development*. Presentation at the National Association for the Education of Young Children Professional Development Institute, Washington, DC.
- Chalufour, I. (2000, June). *Developing performance assessment for teacher education: The next reform*. Presentation at the National Association for the Education of Young Children Professional Development Institute.
- Worth, K., & Chalufour, I. (2000, November). *Raising the bar: Supporting young children's inquiry in science*. Presentation at the preconference session, National Association for the Education of Young Children Annual Conference, Atlanta, GA.
- Dickinson, D. K., Smith, M. W., & Chalufour, I. (1999, April). *Supporting professional growth among Head Start teachers by fostering construction of applied knowledge*. Paper presented at the Annual Meeting of the American Educational Research Association, Montreal, Quebec.
- Chalufour, I. (1999). *Constructing cognitively-challenging curriculum*. Newton, MA: EDC.
- Chalufour, I. (1999, April). *Fostering intentional conversations with children*. Keynote address at Somerville Head Start Literacy Conference, Somerville, MA.
- Chalufour, I. (1999, June). *A systemic approach to enhancing early literacy*. Presentation at the National Association for the Education of Young Children Professional Development Institute, Cincinnati, OH.

KAREN WORTH
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PROFESSIONAL PREPARATION

Radcliffe College, Cambridge, Mass. Biology, BS, 1964; Ann Radcliffe scholar
Participant in two summer teaching projects: Project Tanganyika (English as a Second Language) and Birmingham Project (reading and enrichment for children)

Bank Street College of Education, New York, N.Y., MS, Ed., 1970
Dissertation: Implementation of the African Primary Science Program
Emphasis on cognitive development and creating child-centered learning and teaching. Student teacher in New York Public Schools and Bank Street School for Children.

PROFESSIONAL APPOINTMENTS

Education Development Center, Inc., Newton, Mass.

2004-present Principal Investigator, Connecting Science and Literacy Program: Professional Development Resources for Elementary Teachers.

1999-present Principal Investigator, Tool Kit for Early Childhood Science Education.

1999-present Co-Principal Investigator, EDC K-12 Center for Science Curriculum Dissemination, National Science Foundation.

1995-1999 Co-Director, Center for Urban Science Education Reform, National Science Foundation.

1994-1998 Consultant, Habits of Mind, Cambridge Public Schools.

1992-1995 Chair, Working Group on Science Teaching Standards of the National Committee on Science Education Standards and Assessment of the National Academy of Science.

1991-1996 Principal Investigator, Improving Elementary Science Instruction in the Cleveland Public Schools, National Science Foundation and U.S. Department of Education. Project to assist Cleveland in implementing system-wide reform in elementary science.

1991-1993 Consultant and staff, Association of Science-Technology Centers, Leadership and Renewal Institute.

- 1991–1992 Senior EDC Consultant, Prince George's County Public School District Mathematics and Science Education Reform Initiative, National Science Foundation. Assisted with system-wide elementary science reform.
- 1987–1991 Principal Investigator, Improving Urban Elementary Science, National Science Foundation. Directed development of *Insights, An Elementary Hands-on Inquiry Science Curriculum*, grades K–6 for schools nationwide.

Wheelock College, Boston, Mass.

- 1981–present Faculty, Graduate Division, Wheelock College, Boston, Mass. Designed and taught a five-credit, year-long seminar on issues in education; a three-credit, year-long curriculum design course for the Graduate Teaching Program. Designed and teach a graduate course on science education. Supervise independent studies.
- 2001–present Science consultant to The Young Achievers Science and Mathematics Pilot School, Boston Public School System.
- 1995–2000 Co-Principal Investigator, Focus on Science and TEAMS-BC (Teacher Education Addressing Mathematics and Science in Boston and Cambridge), National Science Foundation, Department of Undergraduate Education.
- 1985–2002 Designer and co-leader of the Learning Teaching Collaborative, an intensive graduate pre service internship program in collaboration with the Brookline and Boston, MA school districts.
- 1975– 1999 Program Director, Boston Schools Collaborative Programs
Responsible for administration, staff selection and support, program planning and evaluation, budget management, and proposal writing for collaborative staff and curriculum development programs between the college and selected elementary schools, districts, departments, and teacher groups in the Boston Public School System.

SELECTED PUBLICATIONS AND PRESENTATIONS

- Chalufour, I., Worth, K., Moriarty, R., Winokur, J., & Grollman, S. (2003). *The Young Scientist Series: Discovering nature with young children* (Teacher's Guide and Trainer's Guide and Video). St. Paul, MN: Redleaf Press.
- Chalufour, I., Worth, K., Moriarty, R., Winokur, J., & Grollman, S. (2004). *The Young Scientist Series: Building structures with young children* (Teacher's Guide and Trainer's Guide and Video). St. Paul, MN: Redleaf Press.
- Worth, K., & Grollman, S. (2003). *Worms, shadows, and whirlpools: Science in the early childhood curriculum*. Portsmouth, NH: Heinemann.
- Worth, K. (1999). The Power of Children's Thinking. In *Inquiry; Thoughts, Views, and Strategies for the K–5 Classroom*. Washington, DC: National Science Foundation.

- Worth, K. (1995). (Development Team Member). *National science education standards*, Washington, DC: National Academy Press.
- Worth, K. (1994). (Principal Investigator). *Insights: An elementary hands-on science curriculum K–6*. Dubuque, IA: Kendall/Hunt Publishing Company.
- Chalufour, I., Hoisington, C., Moriarty, R., Winokur, J., & Worth, K. (2004, January). The science and mathematics of building structures. *Science and Children*, 41(4), 30–34.
- Chalufour, I., Worth, K., Moriarty, R., Winokur, J., & Grollman, S. (2003). *The Young Scientist Series: Discovering nature with young children* (Teacher's Guide and Trainer's Guide and Video). St. Paul, MN: Redleaf Press.
- Chalufour, I., Worth, K., & Winokur, J. (2003, November). *The role of literacy in enhancing science understanding*. Presentation at the National Association for the Education of Young Children Annual Conference, Chicago, IL.
- Century, J., Flynn, J., Makang, D., Pasquale, M., Robblee, K., Winokur, J., & Worth, K. (2002). Supporting the science-literacy connection. In R.W. Bybee (Ed.), *Learning Science and the Science of Learning*. Arlington, VA: NSTA Press.
- Chalufour, I., Worth, K., Moriarty, R., Winokur, J., & Grollman, S. (forthcoming). *The Young Scientist Series: Exploring water with young children (teacher's guide and trainer's guide and video)*. St. Paul, MN: Redleaf Press.
- Chalufour, I., Worth, K., Moriarty, R., Winokur, J., & Grollman, S. (forthcoming). *The Young Scientist Series: Building structures with young children (teacher's guide and trainer's guide and video)*. St. Paul, MN: Redleaf Press.

SELECTED ADVISORY BOARD AND CONSULTANT ROLES

- Member, AERA Grants Program Governing Board: 2000-present
- Director for science, WGBH Project PEEP: A television series for children ages 3–5: 2000–present.
- Advisory Board member, National Science Resources Center, Washington, D.C., 1985–2003.
- Consultant, Project SEED, Pasadena Public Schools, 1990–2000.
- Consultant, Huntsville Alliance for Science, Huntsville, Ala., 1993–1999.
- Advisory Board Member, Teacher to Teacher video project, Mr. Wizard Foundation, Mich., 1992–1997.

Program Director: Clark-Chiarelli, Nancy

Application Number: R305MA5060

Curricula Vitae
Advisors

CURRICULUM VITAE

SUSAN E. CAREY

EDUCATION

Harvard University, Ph.D., 1971

London University, Fulbright Fellowship, 1965

Radcliffe College, B.A., 1964

SELECTED FELLOWSHIPS AND HONORS

National Academy of Sciences, 2002

William James Fellow, American Psychology Society, 2002

American Academy of Arts and Sciences, 2001

Society for Experimental Psychology, 1999

National Academy of Education, 1999

Guggenheim Fellowship, 1999-2000

George A. Miller Lecturer, 1998. Society of Cognitive Neuroscience

SELECTED PROFESSIONAL EXPERIENCE

Academic Positions

2004- Henry A. Morss Jr. and Elizabeth W. Morss Professor of Psychology, Harvard University

2001- Professor, Harvard Department of Psychology

1996-2001 Professor, NYU Department of Psychology

1984-1996 Professor, MIT Department of Brain and Cognitive Sciences

Selected Research and Training Grants and Contracts (Current and Past)

2004-2009 NIH The Development of Cognition. Training grant (PI, S. Carey; 10 co-PIs)

2004-2007 Sources of Mathematical Thinking (co PIs: M. Hauser, E. Spelke)

2001-2004 NSF Sources of Mathematical Thinking (co PIs: M. Hauser, N. Kanwisher, E. Spelke, PI)

2000-2005 NIH Ontology and Quantification in Early Childhood

1991-1994 NSF Using Conceptual Models to Facilitate Conceptual Change: The Case of a Theory of Matter (co-PI, C. Smith)

1988-1990 McDonnell Fdn Teaching for Conceptual Change in Middle School Science: The Role of Models (co-PIs, M. Wiser, C. Smith)

1985-1988 Israeli Acquisition of the concepts *heat* and *temperature*
Binational Fdn (co-PIs, S. Strauss and M. Wiser)

Selected Professional Organizations (Current)

Society for Cognitive Development

Society for Research in Child Development

Society for Philosophy and Psychology, President, 1983-1984

Selected Editorial Boards and Grant Review Panels

Editor (with L. Gleitman, E. Spelke, & E. Newport) of book series: *Learning, Development and Conceptual Change*, MIT Press.

Editorial Boards: *Psychological Review* (Associate Editor, 2000-2003); *Psychological Science*; *Infancy*, *Journal of Language Acquisition*, *Cognition* (past), *Memory and Cognition* (past), *Developmental Psychology* (past).

SELECTED PSYCHOLOGY PUBLICATIONS

Books and Monographs

Carey, S. (1985). *Conceptual Change in Childhood*. Cambridge, MA: Bradford Books, MIT Press.

S. Carey & R. Gelman, Eds. (1991). *The Epigenesis of Mind: Essays on Biology and Cognition*. Hillsdale, NJ: Erlbaum.

Carey, S. (in preparation). *The Origin of Concepts*. MIT Press.

Chapters in Books (* = student)

Carey, S. (1987). Theory change in childhood. In B. Inhelder, D. Caprona & A. Cornce-Wells (eds.), *Piaget Today*. Hillsdale, NJ: Erlbaum, 141-163.

Carey, S. (1988). Cognitive development in childhood. In S. Schiffer and S. Steele (eds.), *Cognition and Representation*. Westview Press, 131-160.

Carey, S. (1988). Why Jane and Johnny aren't learning science. Washington, DC: Federation of Behavioral, Psychological, and Cognitive Sciences: Science and Public Policy Seminars.

Carey, S. (1991). Knowledge acquisition: enrichment or conceptual change? In S. Carey & R. Gelman (eds.), *The Epigenesis of Mind: Essays in Biology and Cognition*. Hillsdale, NJ: Erlbaum, 257-291.

Carey, S. (1993). The origin and evolution of everyday concepts. In R. Giere (ed.), *Cognitive Models of Science (Minnesota Studies in the Philosophy of Science, Vol. XV)*. Minneapolis: University of Minnesota Press, 89-128.

Carey, S., & Spelke, E.S. (1994). Domain specific knowledge and conceptual change. In L. Hirschfeld & S. Gelman (eds.), *Mapping the Mind: Domain Specificity in Cognition and Culture*. Cambridge: Cambridge University Press, 169-200.

Carey, S. (1996). Perceptual classification and expertise. In R. Gelman and T. Au (eds.), *Handbook of Perception and Cognition: Perceptual and Cognitive Development*; New York: Academic Press, 49-69.

Carey, S. (1996). Cognitive domains as modes of thought. In D. Olson (ed.), *Modes of Thought*. Cambridge: Cambridge University Press, 187-215.

Carey, S. (1998). Knowledge of Number: Evolutionary and Ontogenetic Origins. In M. S. Gazzaniga & J. S. Altman (eds.), *Brain and Mind: Evolutionary Perspectives*. Strasbourg: Human Frontier Science Program, 131-149.

Carey, S. (1999). Sources of conceptual change. In E. K. Scholnick, K. Nelson, S. A. Gelman & P. Miller (eds.), *Conceptual Development: Piaget's Legacy*. Hillsdale, NJ: Erlbaum, 293-326.

Slaughter, V*, Jaakkola, K*, & Carey, S. (1999). Constructing a coherent theory. Children's biological understanding of life and death. In M. Siegel & C. Peterson (eds.) *Children's Understanding of Biology and Health*. Cambridge: Cambridge University Press, 71-98.

- Carey, S., & Markman, E. (1999). Cognitive Development. In R.E. Rumelhart & B.O. Martin (eds.), *Handbook of Cognition and Perception, Vol. 1: Cognitive Science*, 201-254.
- Carey, S. & Johnson, S*. (2000). Metarepresentation and conceptual change: Evidence from Williams Syndrome. In Sperber, D. (ed.), *Metarepresentation*. Cambridge: Cambridge University Press, 225-264.
- Carey, S. (2001). Bridging the gap between cognitive development and developmental neuroscience: A case study of the representation of number. In C. A. Nelson & M. Luciana (eds.), *The Handbook of Developmental Cognitive Neuroscience*. Cambridge, MA: MIT Press, 415-432.

Papers in Refereed Journals

- Carey, S. (1986). Cognitive science and science education. *American Psychologist*, 41, 1123-1130. Reprinted in Open University Press, Readings in the Psychology of Education and in C. Hedley, J. Houtz, & A. Baratta (eds.), *Cognition, Curriculum, and Literacy* Norwood, NJ: Ablex, 1990.
- Sodian, B*, Zaitchik, D*, & Carey, S. (1991). Young children's differentiation of hypothetical beliefs from evidence. *Child Development*, 62, 753-766.
- Carey, S., & Smith, C. (1993). On understanding the nature of scientific knowledge. *Educational Psychologist*, 28(3), 235-251.
- Carey, S. & Spelke, E. (1996). Science and core knowledge. *Philosophy of Science*, 63(4), 515-533.
- Carey, S. (2000). The origin of concepts. *Journal of Cognition and Development*, 1, 37-41.
- Carey, S. (2000). Science education as conceptual change. *Journal of Applied Developmental Psychology*, 21(1), 13-19.
- Carey, S. and Xu, F*. (2001). Infant's knowledge of objects: beyond object files and object tracking. *Cognition*, 80, 179-213.
- Huntley-Fenner, G*, Carey, S., & Solimando, A. (2002). Objects are individuals but stuff doesn't count: Perceived rigidity and cohesiveness influence infants' representations of small numbers of discrete entities. *Cognition*, 85(3), 203-221.

Reviews and for the lay audience

- Carey, S. (1999). Children's knowledge of the human body. *Click: Opening Windows for Young Mind*, 2, # 2, v-vi.
- Carey, S. (1999). Children's understanding of sinking and floating. *Click: Opening Windows for Young Minds*, 2, #6, vi-vii.

VITA
Rochel Gelman

Psychology and Cognitive Science
Rutgers University- New Brunswick
152 Freylinghuysen Roald
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Education:

BA, 1963, University of Toronto, Toronto, Canada
MS, 1965, University of California, Los Angeles
Ph.D, 1967, University of California, Los Angeles

Selected Recent Awards and Honors:

Mentor Award, Division 7, APA – Aug., 2003
Inaugural Fellow, Cognitive Science Society, 2002-
Fellow, American Academy of Arts and Sciences, 1999-
William James Fellow, American Psychological Society, 1998-
Distinguished Scientific Contribution Award, American Psychological Association (APA), 1995

Positions 1995-Present:

2000- Professor of Psychology & Cognitive Science, Rutgers University, New Brunswick.
2002 Co-Director, Rutgers Center for Cognitive Science
1989-2000 Professor, Psychology, UCLA,
2000- Professor Emerita, Psychology, UCLA
1999 'F Visiting Professor, Rutgers Center for Cognitive Sciences, Rutgers
1995- 96 Visiting Scholar, Psychology, New York University.
1995-99 Director, NIHM Training Grant in Developmental Cognitive Science,

Professional Affiliations:

American Psychological Association, Divisions 3 & 7; American Psychological Society;
Cognitive Science Society; Piaget Society; Psychonomics Society; Society for Research in
Child Development.

Sample of Recent Professional Activities:

(1.a) *Editorial Boards:* Applied Developmental Psychology, 2000- ; Cognitive Psychology, 1977- ; Mathematical Cognition, 1994-; Substratum, 1992-; Occasional Reviewer, Cognition, Cognitive Development, Psychological Science, Cognitive Science, Nature, Science, Infancy, NIMH, NSF, Canada Council, and comparable councils in Australia and Israel, W.T. Grant Foundation, NY; Carnegie Corp.; NY., NY; Spencer Foundation, NIMH B Start Program; Radcliffe Insdtitute for Advanced Studies.

(1.b) *Co-Associate Editor:* (with Richard Lerner). *International Encyclopedia of Psychology, Developmental Sections*, Chief Editor, A. Kadzin, American Psychological Association.

(2). Advisory Committees or Board Membership - National
Program Committee, for 2005 meeting of the Cognitive Science Society
Psychology Department, Visiting Committee, Harvard University, 2003-05

Governing Board, American Psychological Society, 1999-2002
IRB for Human Subjects, Rutgers University, June 2001-2
Executive Committees, Center for Cognitive Science (F 2000-) and Department of
Psychology (July 2001-) Rutgers-New Brunswick
Long Range Planning Committee, Department of Psychology, Rutgers-New Brunswick
Board of Behavioral, Cognitive, and Sensory Sciences, The National Research Council,
May, 1997-2004
NIH Grant Review Panel, June 2001
Cornell Institute for Research on Children, 2001-
Developmental Review, Canadian Institute for Advanced Research 2002

Publications and Manuscripts:

Books and Monographs

- Gelman, R. and Au, T. (Eds.). (1996). *Cognitive and perceptual developmental. Vol. XIII. Handbook of perception and cognition.* (Eds.) E. Carterette and M. Friedman, Academic Press.
- Gelman, R. (1990). (Guest editor) *Cognitive Science*, 14(1): Title of volume: *Structural constraints on cognitive development.*

Papers and Chapters

- Gelman, R., Romo, L. & Francis, W. (2002). Notebooks as windows on learning: The case of a science-into-ESL program. In N. Granott and J. Parziale (Eds.) *Microdevelopment.* pp. 269-293. Cambridge, Eng: Cambridge Univ. Press.
- Gelman, R. (2002). Animates and other worldly things.(pp.75-87). In Stein, N., Bauer, P., and M. Rabinowitz (Eds). *Representation, Memory, and Development: Essays in Honor of Jean Mandler.* Mahwah, NJ: Lawrence Erlbaum Associates.
- Gelman, R. & Lucariello, J. (2002). Learning in cognitive development. In Pashler, H. & Gallistel, C.R. *Stevens' Handbook of Experimental Psychology, Third Edition, Vol.3.* Wiley: New York.
- Gelman, R., & Brenneman, K. (2004). Relevant pathways for preschool science learning. *Early Childhood Quarterly Review*
- Gelman, R. & Gallistel, C.R. (2004). Language and the origin of numerical cognition. *Science*
- Cordes, S. & Gelman, R. (in press). The young numerical mind: What does it count? In. Campbell, J. (Ed). *Handbook of mathematical cognition.*
- Gallistel, C.R. & Gelman, R. (in press). Mathematical cognition. In (Ed.). K. Holyoak & R. Morrison. *Cambridge handbook of thinking and reasoning.* New York, NY : Cambridge University Press.

Manuscripts/Products

Products

- Gelman, R., Massey, C., Massey, K, McManus, M. (1987-9). In Collaboration with Please Touch Museum, Philadelphia, PA. *Try It Gallery.* An exhibit designed to introduce mathematics and science at levels suitable for children aged 7 years or less and the adults who accompanied them.

Gelman, R. (June, 1991). *The active mind*. Address to the 1991 Phi Beta Kappa Initiates, Chapter Eta, UCLA. (Addresses given by honor electees are published at UCLA).

Recent Talks (* indicates invited)

- *Gelman, R. (2004). *Innate learning or Rational Constructivism*. Colloquium, Depart of Brain and Cognitive Science, Rochester University, Nov.10, 2004.
- * Gelman, R. (2004) *Relevant learning environments for enhancing young children's competence, or: Cognitive science goes to preschool*. Presented at the Congress of the International Union of Psychological Science, August, 2004, Beijing, China.
- *Gelman, R. (2004). *Innate learning and cognitive development*. Presented at the Congress of the International Union of Psychological Science, August, 2004, Beijing, China
- *Gelman, R. (2004). *Numbers in the child's mind*. Presented at the Congress of the International Union of Psychological Science, August, 2004, Beijing, China
- *Gelman, R. (2004). *Preschool pathways for learning*. Presented as part of the National Research Center for Education's workshop on Pre-mathematical development and science exploration in early childhood. NRC, March, 2004, Washington, D.C.
- *Gelman, R. (2004). *Numbers in the mind*. Colloquium, University of Toronto, March, 2004.
- *Gelman, R., (2003). *Where do numbers come from?* Presented as part of an invited symposium entitled "Numbers in the Mind" and organized by Brian Butterworth, British Association for the Advancement of Science, 2003, Manchester, Eng.
- *Gelman, R. (2004). *Cognitive science and mathematics learning*. Presentation at a meeting of the members of the Center for Teaching and Learning, Rutgers Univ., Feb., 2004.
- *Gelman, (2003), *The arithmetic mind*. Colloquium, Yale, Oct. 03.
- Brenneman and Gelman, (2003). *Young children distinguish look-alike real and fabricated animals*. Psychonomics, Vancouver, Canada, Nov.
- *Gelman, R. (2003). *Secrets of the young child's mind: Early learning*. University of Pennsylvania, Graduate School of Education, Dec. 03
- *Gelman, R. (2003). *Secrets of the Infant Mind: Mental Structures and Early Learning* – Series on New Directions in Learning. Stanford University, January, 2003
- Papafragou, A., Hurewitz, F., Gleitman, L. R., Gelman, R. (2003). *Number/quantifier asymmetries in language acquisition*. The Linguistic Society of American
- Hurewitz, F., Gleitman, L.R., & Gelman, R. (2002). Boston Child Language Meeting, Boston University, Boston, MA. Feb., 2002.
- *Gelman, R. (2002). *Mathematics in the preschool*. Early Math Conference, Rutgers Univ., Piscataway, NJ. July 2002.
- Cordes, S. & Gelman. R. (2001). *Counting while talking*. Poster presented at APS Convention, Toronto, Can., June 2001.
- *Gelman, R. *Innate learning: The case of arithmetic*. February, 2002, John Hopkins Univ., Baltimore.

Jacqueline Jones

(b)(6)

(732) 438-1275; jjones@ets.org

EDUCATION

Northwestern University	Ph.D.	Communication Sciences and Disorders: Learning Disabilities
Northwestern University	M.A.	Communication Sciences and Disorders: Learning Disabilities
Hunter College in the Bronx (CUNY)	B.A.	Speech Pathology

EXPERIENCE

2000–present	Director, Early Childhood Research and Development Educational Testing Service, Princeton, NJ
1998-2002	Senior Research Scientist, Research Division, Educational Testing Service, Princeton, NJ
2000-2001	Visiting Associate Professor, Harvard Graduate School of Education, Harvard University, Cambridge, MA
1990-1998	Research Scientist, Division of Cognitive and Instructional Sciences, Educational Testing Service, Princeton, NJ
1990-1991	Adjunct Associate Professor, Lehman College (CUNY), New York, NY
1989-1990	Visiting Scholar, National Assessment of Educational Progress, Educational Testing Service, Princeton, NJ
Summer, 1989	Visiting Assistant Professor, Department of Audiology and Speech Sciences, Purdue University, IN
1984-1989	Assistant Professor, Lehman College (CUNY), New York, NY
1979-1980	Lecturer, Lehman College (CUNY), New York, NY
1972-1979	Director, Learning Disabilities Program, St. Joseph's School for the Deaf, Bronx, NY

SELECTED PROJECTS DIRECTED

1998-4/2002	Co-PI, (with E. Chittenden) Primary Science Documentation: Strategies and Materials (National Science Foundation, \$1,700,000). Product: <i>Understanding Early Science Learning</i> for Pathwise Series.
1995 - 1997	Co-Project Director, (with E. Chittenden) Documenting Young Children's Science Learning (National Science Foundation)
Spring, 1994	Project Director, Consequences of an Early Literacy Portfolio Project on Teachers' Thought and Practice (Center for Performance Assessment, ETS)
1992 - 1994	Project Director, Classroom-Based Documentation of Literacy and Science Development in Programs for Urban Minority Children (subcontract of the Trenton Early Childhood Transition Demonstration Project from the US. Department of Health and Human Services, \$200,000)

INVITED CONFERENCE PRESENTATIONS

Toward a broader vision: assessing children, teachers, programs, and ourselves. Keynote panelist. NAEYC Professional Development Institute, Baltimore, MD June 2004.

Building Meaningful Early Childhood Assessment Systems. DC Universal School Readiness Conference, Washington, DC, May 2004.

Documenting and Assessing: Making it Meaningful. 3rd Annual Early Childhood Conference, Child Care Services of Monmouth County, Tinton Falls, NJ, January 2004.

Assessment and Outcomes: Implications for Early Learning. Children's Defense Fund's 2003 State Advocates Meeting, Alex Haley Farm, Clinton, TN, December, 2003.

Documenting Student Work. Commission on Improving Curriculum-based Assessment. Chicago Public Schools and the Erikson Institute. Chicago, IL, September 2003.

Understanding Children's Learning. Focus on Young Children's Thinking. Rider University Early Childhood Education Program, Lawrenceville, NJ February 2003.

Early Childhood Curriculum and Assessment: a Critical Look at Current Guidelines and an Action Plan for the Future. National Institute for Early Childhood Professional Development of the National Association for the Education for Young Children, Albuquerque, NM, June 2002.

The Year in Early Childhood Research: Highlights and Implications for Policy and Practice. National Institute for Early Childhood Professional Development of the National Association for the Education for Young Children, Albuquerque, NM, June 2002.

CONFERENCE PRESENTATIONS

Assessment: understanding, using, and communicating assessment data. NAEYC Professional Development Institute, Learning from Assessment, Baltimore, MD June 2004.

Effective Early Childhood Assessment Practices. Biennial Conference on Human Development, Washington, DC, April 2004.

Demystifying Assessment: Using Assessment Data To Inform, Understand and Enhance Children's Learning. 2003 Annual Conference of the National Association for the Education for Young Children, Chicago, November 2003.

Demystifying Assessment: Principles and Best Practices in Early Childhood Assessment. 12th National Institute for Early Childhood Professional Development of the National Association for the Education for Young Children, Portland, OR, June 2003.

Effective Early Childhood Assessment Systems. Annual Meeting of the National Council on Measurement in Education, Chicago, IL, April 2003.

Assessing and Understanding Early Science Learning: Identifying, Collecting, and Interpreting Classroom-based Evidence of Young Children's Science Learning. National Institute for Early Childhood Professional Development of the National Association for the Education for Young Children, Albuquerque, NM, June 2002.

Assessment-related Knowledge and Skills of Early Childhood Educators: What Constitutes Effective Teacher Preparation. 2002 Annual Meeting of the American Educational Research Association. New Orleans, LA, April 2002.

Effective Early Childhood Portfolio Assessment Systems: Assessment for Instruction, Accountability, and Program Improvement. NAEYC National Institute for Early Childhood Professional Development, Washington, DC, June 2001.

Classroom-Based Strategies for Documenting the Evidence of Early Science Learning. 1999 Annual Conference of the National Association for the Education of Young Children, New Orleans, LA, November 1999.

Professional Development On-line: A Web-Based Course on Documenting Young Children's Learning. National Institute for Early Childhood Professional Development of the National Association for the Education for Young Children, Cincinnati, OH, June 1999.

Professional Development of Teachers in the Context of Documenting Young Children's Science Learning. Annual Meeting of the American Educational Research Association, Montreal, Canada, April 1999.

Documenting Young Children's Understandings, Annual Meeting of the National Science Teachers' Association, Boston, MA, March 1999.

Redefining Assessment for African American Young Children. The Annual Convention of the Association of Black Psychologists, August 1997.

Documentation and Technology: Implications for Early Childhood Professional Development. National Institute for Early Childhood Professional Development of the National Association for the Education for Young Children, Seattle, WA, June 1997.

Professional Development in the Context of National Board for Professional Teaching Standards Certification: Implications Beyond Certification. Annual Meeting of the American Educational Research Association. Chicago, IL, March, 1997.

Classroom Documentation of Young Children's Science: Supporting Teachers' Observations. 1996 Annual Meeting of the American Educational Research Association. New York, NY, April 1996.

The 1995 NAEP Observational Study of Twelfth Grade Mathematics. 1996 Annual Meeting of the National Council on Measurement in Education, New York City, April 1996.

Teachers As Assessors: A Preliminary Study of the Characteristics That Define a Good Teacher Assessor. 1996 Annual Meeting of the National Council on Measurement in Education, New York, NY April 1996.

WRITINGS

Hyson, M, Copple, C. and Jones, J. (in progress) Bringing Developmental Theory and Research Into the Early Childhood Classroom: Thinking, Emotions, and Assessment Practices. (Volume 4), Handbook of Child Psychology.

Jones, J. (2003). Early Literacy Assessment Systems: Essential elements. Policy perspective for the ETS Policy Information Center. Educational Testing Service, Princeton, NJ.

Jones, J. & Courtney, R. (2002) Documenting Early Science Learning. Young Children, 57(4).

Chittenden, E. & Jones, J. (1998). Science Assessment in Early Childhood Programs. Dialogue on early childhood science, mathematics, and technology education. Washington, DC: Project 2061, American Association for the Advancement of Science.

Jones, J. & Chittenden, E. (1995). Teachers' Perceptions of Rating an Early Literacy Portfolio (Center for Performance Assessment, MS #95-01), Educational Testing Service, Princeton NJ.

Myford, C., Villegas, A. M., Reynolds, A., Camp, R., Danielson, C., Jones, J., Knapp, J., Sims-Gunzenhauser, A., & Sjostrom, B. (1993). Formative studies of Praxis III: classroom performance assessments - an overview RR 94-20, Educational Testing Service, Princeton, NJ.

Morris, L.V., & Jones, J. (1993). Formative Studies of Praxis III: Classroom Performance Assessments - Comparisons of Assessor Approaches to Observing, Note Taking, Coding, and Selecting Processes (Formative Study B4). RM. 94-4, Educational Testing Service, Princeton NJ.

ALINE G. SAYER

(b)(6)

(413) 549-6351; e-mail: sayer@psych.umass.edu

EDUCATION

Harvard University, Graduate School of Education, Cambridge, MA

Doctorate of Education in Human Development and Psychology, 1992

Dissertation: *Chronic illness and academic growth: Modeling individual differences in progress with covariance structure analysis* (Advisor: John B. Willett)

Wheelock College, Boston, MA

Master of Science in Early Childhood Education, 1978

Temple University, Philadelphia, PA

Bachelor of Arts in Psychology, 1970

ACADEMIC APPOINTMENTS

Associate Professor of Psychology 2004

University of Massachusetts

Research Scientist 1999-2004

Harvard University

Lecturer in Psychology 2003-present

University of Massachusetts-Amherst

Assistant Professor of Human Development 1994–1999

Pennsylvania State University

Adjunct Lecturer in Methodology and Research Design 1992–1993

Kennedy School of Government, Harvard University

Instructor in Early Childhood Education 1978–1984

Wheelock College, Boston, MA

AWARDS AND GRANTS

A New Method to Study the Care Receiver-Caregiver Dyad 2003–2004

Co-PI with Karen Lyons

Hugo G. Beigel Research Award 2000

Presented by the Society for the Study of Scientific Sexuality
for the best article published in the *Journal of Sex Research* in 1999

National Institute on Drug Abuse (P50 DA 10075) 1996–2000

Individual Growth Modeling of Substance Use

Principal Investigator

APA Research Conference Award 1998

New Methods for the Analysis of Change

Conference Organizer

Penn State Interdisciplinary Seed Grant 1995–1996

Poverty and Adjustment in Childhood: Measurement and Dynamic Modeling
Co-investigator

Outstanding Dissertation Award in Human Development 1994

Presented by Division E (Human Development and Counseling) of the American Educational Research Association for the outstanding dissertation in human development submitted between July 1992 and June 1993.

National Research Service Award 1992–1994

Post-doctoral fellowship awarded by the National Institutes of Mental Health

Statistical Institute for the Analysis of Educational Policy 1993

Grant awarded by the American Educational Research Association to attend the institute on applying hierarchical models to national educational databases

Henry A. Murray Dissertation Fellowship 1990–1991

Grant awarded by the Murray Research Center of Radcliffe College for outstanding thesis research focusing on the study of lives over time.

PROFESSIONAL AFFILIATIONS

American Educational Research Association (proposal reviewer), American Psychological Association Society for Research in Adolescence, Society for Research in Child Development (proposal reviewer)

PUBLICATIONS

Journal Articles and Book Chapters

Hauser-Cram, P., Warfield, M. E., Shonkoff, J. P., Krauss, M. W., Sayer, A. G., & Upshur, C. C. (Expected April 2005). Children with Disabilities: Child Development and Parent Well-Being. In H.B. Weiss, H. Kreider, M.E. Lopez, & C. Chatman (Eds.) *Preparing educators to involve families: From theory to practice* (Weiss, H.B., Kreider, H., Lopez, M.E., & Chatman, C., Eds.). Thousand Oaks, CA: Sage Publications.

Lyons, K. & Sayer, A. G. (expected 2005). Longitudinal dyad models in family research. *Journal of Marriage and Family*.

Lyons, K. & Sayer, A. G. (expected 2004). Using multilevel models in caregiving research. *Aging and Mental Health*.

Sayer, A. G. & Klute, M. M. (2004). Multilevel models for dyadic data. In *Sourcebook of family theory and research* (A. Acock & V. Bengtson, Eds.). Newbury Park CA: Sage.

Klute, M. M., Crouter, A. C., Sayer, A. G., & McHale, S. M. (2002). Occupational self-direction, values, and egalitarian relationships: A study of dual-earner couples. *Journal of Marriage and the Family*, 64, 139- 151.

Zweig, J.M., Sayer, A. G., Crockett, L. J., & Vicary, J. R. (2002). Adolescent risk factors for sexual victimization: A longitudinal analysis of rural women. *Journal of Research in Adolescence*, 17(6), 586- 603.

- Collins, L. M. & Sayer, A. G. (2001). *New methods for the analysis of change*. Washington DC: APA Publications.
- Sayer, A., & Cumsille, P. (2001). Second-order latent growth models. In Collins, L. M. and Sayer, A. G. (Eds). *New methods for the analysis of change* (pp.179-200). Washington DC: APA Publications.
- Hauser-Cram, P., Warfield, M., Shonkoff, J., Krauss, M., Sayer, A., & Upshur, C. (2001). Children with disabilities: A longitudinal study of child development and parent well-being. *Monographs of the Society for Research in Child Development*, 66 (3, Serial No. 266).
- Collins, L. M. & Sayer, A. G. (2000). Modeling growth and change processes: Design, measurement, and analysis for research in social psychology. In Harry Reis and Charles Judd (Eds.), *Handbook of research methods in social and personality psychology* (pp. 478-495). NY: Cambridge University Press.
- Sayer, A. G. & Willett, J. B. (1998). A cross-domain model for growth in adolescent alcohol expectancies. *Multivariate Behavioral Research*, 33, 509-543.
- Willett, J. B., & Sayer, A. G. (1996). Cross-domain analyses of change over time: Combining growth modeling and covariance structure analysis. In G. A. Marcoulides and R. S. Schumacker (Eds.), *Advanced structural equation modeling: Issues and techniques* (pp. 125- 157). Hillsdale NJ: Erlbaum.

INVITED LECTURES AND SHORT COURSES

- Sayer, A. G. (September 2004). Introduction to Hierarchical Linear Models. A short course sponsored by the Inter-University Consortium for Social and Political Research. SAMSI, Research Triangle Park, NC.
- Sayer, A. G. (June 2002; July 2003). *Hierarchical Linear Models*. A short course sponsored by the Inter-University Consortium for Social and Political Research. University of Michigan, Ann Arbor
- Sayer, A. G. (June 2003). *Hierarchical Linear Models for Longitudinal and Dyadic Data*. A short course sponsored by the Inter-University Consortium for Social and Political Research. Cambridge MA.
- Sayer, A. G. (March 2003). *New Missing Data Methods*. Invited lecture for the Workshop on Stability of Methods for Collecting, Analyzing, and Managing Panel Data. National Science Foundation, Cambridge MA.
- Sayer, A. G. (November 2002). *Using multilevel modeling to analyze dyadic data*. Invited lecture to the National Council on Family Relations. Houston, TX.
- Sayer, A.G. & Raudenbush, S. R. (July 2000 through July 2004). *Advanced topics in hierarchical linear modeling*. A short course sponsored by the Inter-University Consortium for Social and Political Research. University of Michigan, Ann Arbor.
- Sayer, A.G. (June 2001). *Hierarchical linear modeling*. A short course sponsored by the Oregon Social Learning Center, Eugene OR.
- Sayer, A. G. (1991). Impact of chronic illness on change in *adjustment: Integrating growth modeling and covariance-structure analysis to investigate individual differences in growth*. Paper presented at the meeting of the Society for Research on Child Development, Invited Symposium on *Using Growth Modeling to Analyze Longitudinal Developmental Data*.

**Budget
and
Budget Justification**

EDUCATION DEVELOPMENT CENTER, INC.
Assessing the Potential Impact of a PD Program in Science on Head Start Teachers and Children
BUDGET DETAIL
Year 1

A. DIRECT LABOR

Assumes July 1, 2005 Start

Position	Person	% Time/ No. Days	Salary/ Day Rate	Total
Prin. Investigator	Nancy Clark-Chiarelli	(b)(6)		\$ 19,392
Co-Prin. Investigator	Jess Gropen			\$ 42,000
Sr. Research Assoc	Miriam Smith			\$ 12,762
Sr. Research Associate	Costanza Eggers-Pierola			\$ 8,474
Research Assistant	To Be Named	50%	\$ 31,811	\$ 15,906
Sr. Prof. Devt Specialist	Ingrid Chalufour	80%	\$ 84,003	\$ 67,203
Sr. Prof. Devt Specialist	Karen Worth	(b)(6)		\$ 10,343
Co-Instructor	Jeff Winokur			\$ 9,990
Video Producer	David Nelson			\$ 4,490
Admin. Assistant	To Be Named	50%	\$ 31,000	\$ 15,500
Direct Labor				\$ 206,058
Fringe Benefits				27.2% \$ 206,058 \$ 56,048

TOTAL DIRECT LABOR**\$ 262,106****B. OTHER DIRECT COSTS**

Object Class	Object	Unit	No. of Units	Unit Cost	Subtotal	Total
TRAVEL						
Meeting with Staff and Grantees	Airfare/BOS-DCA	RT	1	\$ 450	\$ 450	
	Food/Lodging	Night	2	\$ 204	\$ 408	
	Ground Transportation	Trip	1	\$ 100	\$ 100	
Pilot Test	Travel to ABCD Sites	Trip	12	\$ 6.00	\$ 72	
	Parking at ABCD Office	Trip	8	\$ 20.00	\$ 160	
Meetings with Research Sites	Travel to Avon	Trip	2	\$ 18.75	\$ 38	
	Travel to Fitchburg	Trip	2	\$ 37.50	\$ 75	
	Travel to Framingham	Trip	2	\$ 11.25	\$ 23	
	Travel to Waltham	Trip	2	\$ 3.75	\$ 8	
Advisor Travel	Airfare/Newark-Boston	RT	2	\$ 498	\$ 996	
	Ground Transportation	Trip	2	\$ 100	\$ 200	
	Travel - Amherst-Newton	Trip	1	\$ 75.00	\$ 75	
	Meal for Advisors	Day	3	\$ 25	\$ 75	
					\$ 2,679	

Application Number: R305MA5060

PARTICIPANT SUPPORT		UMass Credits	Person	15	\$	335	\$	5,025	
		Fdn Student Notebook	Person	15	\$	10	\$	145	
		Supper, Breakfast, Lunch	Meals	136	\$	18	\$	2,448	
		(15 Students + 2 Instructors x 8 Sessions for 1 Meal and Refreshments/Session at \$18)							
		Classroom Materials					\$	1,000	
		Printing Instructor Materials	Person	2	\$	31	\$	62	
									\$ 8,680
CONSULTANTS		Videographer	Day	8	\$	475	\$	3,800	
		Sound Engineer	Day	4	\$	360	\$	1,440	
		Advisor Stipends	Person	4	\$	1,500	\$	6,000	
		(Carey, Gelman, Jones, Sayer)							
									\$ 11,240
MATERIALS AND SERVICES		Office Supplies	Month	12	\$	100	\$	1,200	
		Woodcock Johnson III	Kit	4	\$	150	\$	600	
		Bateria Woodcock-Munox-Revisada		4	\$	151	\$	604	
		Woodcock Johnson III	Set/25	19	\$	36.60	\$	695	
		WJ Spanish Version	Set/25	7	\$	36.60	\$	256	
		Pre-LAS	Manual	4	\$	117	\$	468	
		Pre-LAS Forms	Set	7	\$	25	\$	175	
		ECERS-R	Manual	8	\$	12.95	\$	104	
		PLS-4	Kit	4	\$	169	\$	676	
		PLS-4 Spanish Edition	Kit	4	\$	169	\$	676	
		PLS-4	Set/50	12	\$	114	\$	1,368	
		PLS-4 Spanish Edition	Set/50	5	\$	114	\$	570	
		Postage and Mailing	Month	12	\$	100	\$	1,200	
		Copying	Month	12	\$	75	\$	900	
		Telephone/Fax	FTE	3.17	\$	1,912	\$	6,060	
		Rent & Maintenance	FTE	3.17	\$	15,969	\$	50,617	
		Computer	Each	1	\$	1,600	\$	1,600	
		NUD*ST Software					\$	560	
		SAS License					\$	1,000	
		Advisory Mtg Expenses	Cont'l Breakfast & Lunch	Person	8	\$	18	\$	144
									\$ 69,473
TOTAL OTHER DIRECT COSTS									\$ 92,072
TOTAL DIRECT COSTS									\$ 354,177
INDIRECT COSTS 33.5%									\$ 115,742
TOTAL PROJECT COSTS, Year 1									\$ 469,919

EDUCATION DEVELOPMENT CENTER, INC.
Assessing the Potential Impact of a PD Program in Science on Head Start Teachers and Children
BUDGET DETAIL
Year 2

A. DIRECT LABOR

Position	Person	% Time/ No. Days	Salary/ Day Rate	Total
Prin. Investigator	Nancy Clark-Chiarelli	(b)(6)		\$ 30,542
Co-Prin. Investigator	Jess Gropen			\$ 44,100
Sr. Research Associate	Miriam Smith			\$ 11,725
Sr. Research Associate	Costanza Eggers-Pierola			\$ 12,456
Research Assistant	To Be Named			\$ 16,701
Sr. Prof. Devt Specialist	Ingrid Chalufour			\$ 48,512
Sr. Prof. Devt Specialist	Karen Worth			\$ 5,430
Co-Instructor	Jeff Winokur			\$ 10,489
	Christina Silvi			\$ 7,014
Admin. Assistant	To Be Named	50%	\$ 32,550	\$ 16,275
Direct Labor				\$ 203,244
Fringe Benefits				27.2% \$ 203,244 \$ 55,282

TOTAL DIRECT LABOR**\$ 258,526****B. OTHER DIRECT COSTS**

Object Class	Object	Unit	No. of Units	Unit Cost	Subtotal	Total
TRAVEL						
Meeting with Staff and Grantees	Airfare/BOS-DCA	RT	1	\$ 468	\$ 468	
	Food/Lodging	Night	2	\$ 212	\$ 424	
	Ground Transportation	Trip	1	\$ 104	\$ 104	
Travel for PD Session	Travel to Framingham	Trip	8	\$ 11.70	\$ 94	
Travel for Mentoring	Travel to Avon	Trip	10	\$ 19.50	\$ 195	
	Travel to Fitchburg	Trip	10	\$ 39.00	\$ 390	
	Travel to Framingham	Trip	10	\$ 11.70	\$ 117	
	Travel to Waltham	Trip	10	\$ 3.90	\$ 39	
Advisor Travel	Airfare/Newark-Boston	RT	2	\$ 518	\$ 1,036	
	Ground Transportation	Trip	2	\$ 104	\$ 208	
	Travel - Amherst-Newton	Trip	1	\$ 78.00	\$ 78	
	Meal for Advisors		3	\$ 26.00	\$ 78	
					\$ 3,231	
PARTICIPANT SUPPORT						
	Control Group Incentives	Person	29	\$ 100	\$ 2,900	
	UMass Credits	Person	43	\$ 335	\$ 14,405	

Fdn Student Notebook	Person	43	\$	10.05	\$	432
Supper, Breakfast, Lunch	Meals	336	\$	19	\$	6,290
(40 Students + 2 Instructors x 8 Sessions for 1 Meal and Refreshments/Session @ \$19)						
Printing Instructor Materials	Person	2	\$	32	\$	64
Classroom Materials	Classroom	43	\$	100	\$	<u>4,300</u>

\$ 28,391

CONSULTANTS	Advisor Stipends	Person	4	\$	1,500	\$	6,000
	(Carey, Gelman, Jones, Sayer)						
	Data Collectors (Teacher)	Hour	862	\$	14.00	\$	12,068
	Data Collectors (Child)	Hour	688	\$	11.00	\$	<u>7,568</u>

\$ 25,636

MATERIALS AND SERVICES	Office Supplies	Month	12	\$	104	\$	1,248
	Postage and Mailing	Month	12	\$	104	\$	1,248
	Copying	Month	12	\$	78	\$	936
	Telephone/Fax	FTE	3.09	\$	2,007	\$	6,199
	Rent & Maintenance	FTE	3.09	\$	16,767	\$	51,779
Advisory Mtg Expenses	Cont'l Breakfast & Lunch	Person	8	\$	19	\$	152
	Food for Data Collector Training		40	\$	19	\$	<u>760</u>
	(8 People x 3 Days @ \$20/Day and 8 People x 2 Days @ \$19/Day)						

\$ 62,323

TOTAL OTHER DIRECT COSTS \$ 119,581

TOTAL DIRECT COSTS \$ 378,107

INDIRECT COSTS 33.5% \$ 349,715 \$ 117,155

TOTAL PROJECT COSTS, Year 2 \$ 495,261

EDUCATION DEVELOPMENT CENTER, INC.
Assessing the Potential Impact of a PD Program in Science on Head Start Teachers and Children
BUDGET DETAIL
Year 3

A. DIRECT LABOR

Position	Person	% Time/ No. Days	Salary/ Day Rate	Total
Prin. Investigator	Nancy Clark-Chiarelli	(b)(6)		\$ 42,759
Co-Prin. Investigator	Jess Gropen			\$ 54,023
Sr. Research Associate	Miriam Smith			\$ 10,552
Sr. Research Associate	Costanza Eggers-Pierola			\$ 11,211
Research Assistant	To Be Named			\$ 4,753
Sr. Prof. Devt Specialist	Ingrid Chalufour			\$ 27,784
Sr. Prof. Devt Specialist	Karen Worth			\$ 5,702
Admin. Assistant	To Be Named	50%	\$ 34,178	\$ 17,089
Direct Labor				\$ 173,871
Fringe Benefits				27.2% \$ 173,871 \$ 47,293

TOTAL DIRECT LABOR

\$ 221,164

B. OTHER DIRECT COSTS

Object Class	Object	Unit	No. of Units	Unit Cost	Subtotal	Total
TRAVEL						
Meeting with Staff and Grantees	Airfare/BOS-DCA	RT	2	\$ 487	\$ 973	
	Food/Lodging	Night	4	\$ 221	\$ 883	
	Ground Transportation	Trip	2	\$ 108	\$ 216	
Conference Presentations	Airfare	RT	10	\$ 500	\$ 5,000	
	Food/Lodging	Night	20	\$ 200	\$ 4,000	
	Ground Transportation	Trip	10	\$ 108	\$ 1,082	
Advisor Travel	Airfare/Newark-Boston	RT	2	\$ 539	\$ 1,077	
	Ground Transportation	Trip	2	\$ 108	\$ 216	
	Travel - Amherst-Newton	Trip	1	\$ 81.12	\$ 81	
	Meal for Advisors		3	\$ 27.04	\$ 81	
					\$ 13,610	
CONSULTANTS						
Advisor Stipends (Carey, Gelman, Jones, Sayer)	Person		4	\$ 1,500	\$ 6,000	
	Additional Methodological Consultation		4	\$ 1,500	\$ 6,000	
	Publications Editor	Day	10	\$ 350	\$ 3,500	
					\$ 15,500	

Application Number: R305MA5060

MATERIALS AND SERVICES	Office Supplies	Month	12	\$	108	\$	1,298
	Postage and Mailing	Month	12	\$	108	\$	1,298
	Copying/Printing	Month	12	\$	81	\$	973
	Telephone/Fax	FTE	2.35	\$	2,108	\$	4,957
	Rent & Maintenance	FTE	2.35	\$	17,605	\$	41,403
	SAS License					\$	1,000
Advisory Mtg Expenses	Cont'l Breakfast & Lunch	Person	8	\$	20	\$	<u>160</u>
							<u>\$ 51,089</u>
TOTAL OTHER DIRECT COSTS							<u>\$ 80,199</u>
TOTAL DIRECT COSTS							\$ 301,363
INDIRECT COSTS			33.5%		\$ 301,363	<u>\$ 100,957</u>	
TOTAL PROJECT COSTS, Year 3							<u><u>\$ 402,320</u></u>
TOTAL PROJECT COSTS, All Years							\$ 1,367,500

BUDGET NOTES

Education Development Center, Inc. proposes to develop *Foundations of Science Literacy*, a credit-bearing professional development program, and study its impact on teacher practices and children's learning. In Year 1 we will develop *Foundations*, using two main components: face-to-face instructional sessions supplemented by a mentoring component. We will then conduct a pilot test at Action for Boston Community Development (ABCD), a large Head Start grantee in Boston, Massachusetts. We will use these pilot-test results to refine the intervention for delivery the following year. At the same time, we will launch the development of two types of instruments to assess science teaching and children's learning, pilot testing these also in Year 1. In Year 2 *Foundations* will be revised and tested using a pre-post experimental design. Four Massachusetts Head Start programs will participate in the study: Communities United, Inc. (CUI) in Waltham, Montachusett Opportunity Council, Inc. (MOC) in Fitchburg, Self-Help, Inc. in Avon, and South Middlesex Opportunity Council (SMOC) in Framingham. The budget period is 36 months. The following budget notes provide an explanation of each line item in the budget.

PERSONNEL

Salaries listed in the budget are composite salaries based on those expected to be in effect when the project begins and the salary increases that are due on the anniversary date of the employee's hire. In subsequent years, we have increased salaries by five percent. Actual increases begin on the anniversary date of the employee's hire.

Dr. Nancy Clark-Chiarelli will serve as principal investigator at (b)(6) percent time in Year 1, (b)(6) percent time in Year 2, and (b)(6) percent time in Year 3. She will oversee all aspects of the research, including obtaining IRB approval, refining the research design, and overseeing its implementation. A skilled methodologist, she will provide conceptual leadership to the research team, oversee the analyses, and will be instrumental in disseminating findings through papers and presentations. Dr. Clark-Chiarelli will represent the project at annual meetings with the Institute staff, conferences, and other events.

Dr. Jess Gropen will serve as co-principal investigator at (b)(6) percent time in Years 1 and 2 and (b)(6) percent time in Year 3. Working closely with the PI, he will manage the day-to-day operations of the project, finalize site agreements, monitor time lines, supervise staff, and play a major role in preparing reports and disseminating findings. As an accomplished cognitive scientist, he will play a leadership role in designing and testing new instruments to assess science teaching and learning. He also will revise the Science Teaching and Environment Rating Scale and test it in pilot classrooms. He will assist in the implementation of the research design, having lead responsibility for quantitative analyses.

Dr. Miriam Smith is bid as senior research associates at 40 days in Year 1, 35 days in Year 2, and 30 days in Year 3. Dr. Smith will work closely with the research team, particularly the Co-Principal Investigator, to contribute her expertise in performance assessment and science teaching and learning to the development of new instruments and the refinement of Science

Teaching and Environment Rating Scale. She will also contribute to project reports and the dissemination of findings

Dr. Costanza Eggers-Piérولا is bid a senior research associate for 25 days in Year 1, 35 days in Year 2 and 30 days in Year 3. Dr. Eggers-Piérولا is Spanish-speaking and will draw on her background in science education and qualitative research to collect qualitative data on the engagement and science learning of children who are English language learners. She will also contribute to project reports and the dissemination of findings.

A **research assistant** will be named to support the efforts of the research team. This person will spend 50 percent time in Years 1 and 2, and 30 days in Year 3. In Year 1, s/he will assist in the collection of background data and work with the sites to ensure timely collection of permissions. In Year 2, s/he will prepare data collection materials, assist with the tracking of data collection, and enter data. In Year 3 s/he will aid in development of publications and presentation to disseminate findings.

Ingrid Chalufour and **Karen Worth** will serve as senior professional development specialists. Ms. Chalufour will work (b)(6) percent time in Year 1 and (b)(6) percent time in Year 2, and 30 percent time in Year 3. In Year 1 she will have lead responsibility for development of *Foundations*, oversee the video collection and editing, and design mentoring component. She will serve as the lead instructor and mentor for the pilot test teachers. In Year 2 she will make the necessary revisions to *Foundations* and serve as the lead instructor and mentor for the full implementation of the intervention. In Year 3 she will participate in dissemination activities, contributing to journal articles and conference presentations.

Ms. Worth will spend 20 days in Year 1 and 10 days in Years 2 and 3. She will contribute her strong science and science education knowledge to the development of *Foundations*, helping design the science learning activities and producing science readings. In Year 3 she will participate in dissemination activities, contributing to journal articles and conference presentations.

Jeff Winokur will be a *Foundations* co-instructor spending 30 days each in Years 1 and 2. In Year 1, he will assist in the development and piloting of *Foundations*; in Year 2 he will be a co-instructor assisting Ms. Chalufour with grading assignments and mentoring intervention teachers. He also will help revise *Foundations* in Year 2.

Christina Silvi will join the project in Year 2 for 30 days as a co-instructor to assist with the large number of intervention teachers. She will assist Ms Chalufour in delivering *Foundations*, grading assignments, and mentoring intervention teachers at the four participating sites.

David Nelson is bid as producer of video vignettes and will spend 10 days in Year 1 overseeing the taping and editing the vignettes for use in *Foundations*.

An **administrative assistant** will be named to provide all support services for the project at 50 percent time in each year. This person will manage all correspondence, establish and maintain project files, make logistical arrangements, assist with data entry, prepare and format the

Foundations Instructors' Guide, and prepare manuscripts and other materials for publication and presentations.

FRINGE BENEFITS

EDC's fringe benefits rate is 27.2 percent. The Federal government, as part of our negotiated rate agreement, approves this fixed rate.

OTHER DIRECT COSTS

Travel

The principal investigator will travel to Washington, D.C. to attend the annual meeting with IES staff and other grantees. This trip is required in the RFP.

In each year, project staff will travel to the sites for meetings, recruitment, and data collection purposes. In Year 1, we have budgeted for 12 trips to ABCD sites in Boston to conduct the pilot tests. At the end of Year 1, representatives from the research team will make two trips to each of the four research sites to finalize site agreement and begin recruitment of the sample. In Year 2 ten site visits will be made by members of the research team to collect qualitative data and by *Foundations* instructors to mentor participating teachers.

Each year we will convene one meeting of the four advisors, which will require travel for two advisors from New Jersey and one advisor from Amherst, Massachusetts. They will also be paid for one meal during their travel time. The fourth advisor lives locally and will not need travel reimbursement.

In Year 3, we have added travel to make conference presentations at relevant meetings such as American Educational Research Association, National Science Teachers Association, National Association for the Education of Young Children (NAEYC) Professional Development Conference and NAEYC Annual Meeting, Head Start Research Conference, and Society for Research in Child Development. The budget provides for some of these presentations to be done by two staff.

EDC's policy is to make long-distance travel arrangements far enough in advance to obtain the lowest possible fares. Travelers, however, cannot always meet the applicable airline restrictions. Figures for meals and lodging are given at the government-approved rates for known destinations. Local travel is reimbursed at \$.375 per mile, the current Federal mileage rate. Only actual expenses incurred are reimbursed.

Participant Support

Participant support consists of a \$100 incentive for each of the 29 control teachers, *Foundations* notebooks and classroom materials to ensure teachers ability to implement the curriculum. We will pay the cost of participant tuition for the University of Massachusetts of \$335 for 15 teachers in Year 1 and 43 teachers in Year 2. The project also will supply participants with a meal and refreshments during each of the eight *Foundations* sessions. This will allow for full use of the class time. The budget also provides for the cost of materials and meals for the two

instructors. In Year 2, each participants' classroom will receive \$100 to purchase classroom materials essential for implementing *Foundations*.

Consultants

Each year, our four advisors, Drs. Susan Carey, Rochel Gelman, Jacqueline Jones, and Aline Sayer, will received a stipend of \$1,500 for their work on the project. This stipend covers time preparing for and attending an annual advisor board meeting as well as review of key documents and individual consultation. In Year 3, we have budgeted an additional four days for Dr. Sayer, who will be called on for her methodological expertise as analysis of data is undertaken.

To produce the video in Year 1, we will pay two videographers for a total of eight days and a sound engineer for four days to ensure a quality production of digital video.

In Year 2, the project will use graduate students to collect data on teachers and children. The five teacher data collectors, who will be paid at \$14 per hour, will spend five hours collecting data twice from 42 classrooms for a total of 420 hours. In addition they will be provided with three days of training for a total of 120 hours. Child data collectors will be paid \$11 per hour. They will spend 30 minutes testing 280 children at two points in time for a total of 280 hours and one hour testing the 140 English language learners at two points in time for a total of 280 hours. The eight child data collectors will have two days of training for an additional 128 hours.

In Year 3, we have budgeting 10 days of an editor to assist with the development of manuscripts submitted for publication to a range of professional journals.

Materials and Services

The supplies budget includes general office and computer materials. In Year 1, we will purchase instruments including the Woodcock-Johnson III in English and Spanish, Preschool Language Scale in English and Spanish, Pre-LAS, , and ECERS-R. Prices include EDC's 25 to 40 percent discount. We will purchase NUD*ST software to use for video analysis in the qualitative research. In addition we have budgeted food for the full-day sessions in which we will train data collectors.

Estimates for postage and mailing, copying, and printing are based on EDC's experience with projects of similar scope. Only actual expenses are charged to the project. Telephone and fax charges are allocated to each EDC project based on the number of full-time equivalent employees (FTE) at an annual cost of \$1,912. Rent and maintenance charges are estimated at \$15,969 per FTE. EDC purchases a license for SAS software. The project's portion is estimated to be \$1000 in Years 1 and 3.

INDIRECT COST RATES

EDC has indirect cost rates audited by the U.S. Department of Health and Human Services (Region II). Our current rate agreement of September 22, 2003 sets provisional rates of 33.5 percent on total direct costs (less equipment, subcontracts, and renovation) and 5 percent on subcontracts. EDC's indirect cost rate does not cover expenses that can be allocated to individual projects, such as rent and maintenance of office and conference space and the purchase of computers and related software. The rate of 33.5 percent is applied to all direct costs, except those that fall into the category of Participant Costs.

EDC's cognizant audit agency is the Cost Allocation Division, Region II, D/HHS, Federal Building, 26 Federal Plaza, New York City, New York, 10278.

EDC's indirect costs cover the following business expenses:

Accounting and Purchasing Services: EDC's indirect costs support the staff and related expenses necessary to prepare detailed monthly computerized accounting reports, handle payroll and state and federal taxes, and maintain accounts receivable and payable.

Legal and Personnel Services: EDC's indirect costs support the staff and related expenses necessary to assist with all contractual arrangements; advise project staff regarding confidentiality, legal requirements, permissions, and royalties; and staff to oversee employment and employee benefits.

Corporate Management and Review: EDC's indirect costs support the staff and related expenses of the president, vice presidents, and other members of senior management who also serve as advisors to projects and reviewers of products and reports.

Contract Management: EDC's indirect costs support the staff and related expenses necessary to prepare financial reports, provide financial monitoring, and provide guidance to staff on any budget concerns.

Program Development Services: EDC's indirect costs support the expenses required to develop proposals and projects, publicize project information and findings, disseminate information, advise on report design, and maintain contact with EDC's extensive network of scholars and practitioners.

INDIRECT COST RATES

EDC has indirect cost rates audited by the U.S. Department of Health and Human Services (Region II). Our current rate agreement of September 22, 2003 sets provisional rates of 33.5 percent on total direct costs (less equipment, subcontracts, and renovation) and 5 percent on subcontracts. EDC's indirect cost rate does not cover expenses that can be allocated to individual projects, such as rent and maintenance of office and conference space and the purchase of computers and related software. The rate of 33.5 percent is applied to all direct costs, except those that fall into the category of Participant Costs.

EDC's cognizant audit agency is the Cost Allocation Division, Region II, D/HHS, Federal Building, 26 Federal Plaza, New York City, New York, 10278.

EDC's indirect costs cover the following business expenses:

Accounting and Purchasing Services: EDC's indirect costs support the staff and related expenses necessary to prepare detailed monthly computerized accounting reports, handle payroll and state and federal taxes, and maintain accounts receivable and payable.

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Program Development Services: EDC's indirect costs support the expenses required to develop proposals and projects, publicize project information and findings, disseminate information, advise on report design, and maintain contact with EDC's extensive network of scholars and practitioners.

Appendix A

Table 3: Research Measures

**Table 4: Conceptual Framework for Analyzing
Science Process Skills & Knowledge**

Letters of Agreement (Participants and Advisors)

Table 3: Research Measures

CHILD ASSESSMENTS	CONSTRUCT	PSYCHOMETRICS AND HISTORY
WJ III: Applied Problems & Quantitative Concepts¹ Batería Woodcock - Muñoz - Revisada²	Cognition as related to mathematics including analyzing and solving math problems and knowledge of mathematical concepts, symbols, and vocabulary	Validity and reliability established using continuous-year norms with N=8,818. Reliability coefficients are .90 and higher.
PLS-4³ PLS-4 Spanish Edition⁴	Receptive and expressive language	Normed on national sample of 15,000 children. General: Test-retest stability coefficient range from .90-.97 for Total Language Score. Internal reliability coefficients range from .86-.93. Inter-rater reliability of 99%.
pre-LAS 2000⁵ (ELL children only)	English oral language proficiency	Reliability established using a seven state sample in 1997 (N=956). Reliability coefficients ranged from .76 to .91. Test-retest reliability coefficients .76 to .94.
Preschool Science Assessment (PSA)	Concepts, facts, and skills in physical and life science domains	Under development
TEACHER/CLASSROOM RATINGS		
ECERS-R: Language – Reasoning, Activities, and Interaction Scales⁶	Global classroom quality	Reliability with FACES data has internal consistency of .97, test-retest .82. Predictive validity of .42 was found with the ECLS-K Reading scale in 1999 and 2000.
Science Teaching & Environment Rating Scale⁷	Quality of inquiry-based science instruction	Chronbach's alpha (α =.94)
Science Teaching Performance Tasks (STPT)	Ability to apply pedagogical content knowledge in science teaching contexts	Under development

References

1. Woodcock, R., McGrew, K., & Mather, N. (2001). *Woodcock-Johnson III*. Itasca, IL: Riverside Publishing.
2. Woodcock, R., & Muñoz-Sandoval, A. F. (1996). *The Bateria Woodcock-Muñoz-Revisada (Bateria-R)*. Itasca, IL: Riverside Publishing.
3. Zimmerman, I. L., Steiner, V. G., & Pond, R. E. (2002). *Preschool language scale, 4th ed. (PLS-4) English edition*. San Antonio, TX: The Psychological Corporation.
4. Zimmerman, I. L., Steiner, V. G., & Pond, R. E. (2002). *Preschool language scale, 4th ed. (PLS-4) Spanish edition*. San Antonio, TX: The Psychological Corporation.
5. Duncan, S., & De Avila, E. (2000). *Preschool language assessment scales 2000 (Pre-LAS 2000)*. Monterey, CA: CTB McGraw-Hill.
6. Harms, T., Clifford, R. M., & Cryer, D. (1998). *Early childhood environment rating scale* (Rev. ed.). New York: Teachers College Press.
7. Chalufour, I., Worth, K., & Clark-Chiarelli, N. (2003). *Science teaching and environment rating scale*. Unpublished manuscript.

Table 4: Conceptual Framework for Analyzing Science Process Skills & Knowledge

SCIENTIFIC PROCESS SKILL	NON-LINGUISTIC CUE	LINGUISTIC CUE
“Naturalistic Observation”*	Seeking the sensory experience of a naturally occurring phenomenon	Describing the sensory experience of a naturally occurring phenomenon
Sensing (seeing, touching, hearing, tasting, smelling)	Looking at, manipulating, listening for, tasting, or sniffing something	Stating that you are seeing, feeling, hearing, tasting, or smelling something
Comparing	Comparing two instances of a phenomenon, without bringing either one about	Describing similarities or differences between two (or more) instances
Analyzing, measuring, counting	e.g., Counting (on fingers) the frequency of a phenomenon, or of an attribute of a phenomenon	e.g., Describing visual or spatial attributes of something on the basis of seeing it. Similarly for other sensory modalities
Classifying	Grouping together or sorting phenomena	e.g., Stating that something is an instance of something else
Defining	NA	Stating what a word means in the scientific context, or making up a new word to describe something
“Controlled Experimentation”*	Actively causing a phenomenon to occur, with the intent of understanding it	Describing the activity of causing a phenomenon to occur, with the intent of understanding it
Causing	Causing a phenomenon to occur, but not systematically varying anything while bringing it about, or making any critical comparisons.	Stating that you intend to do something, or that you are doing something, in the context of trying to understand it
Controlling	Causing a phenomenon to occur, and comparing instances that differ in some critical regard.	Describing the similarities or differences between two (or more) instances

*The quotation marks indicate developmentally appropriate and foundational level of these categories of Science Process Skills.

(Table 4 continued on next page.)

**Table 4: Conceptual Framework for Analyzing Science Process Skills & Knowledge
(cont'd)**

SCIENTIFIC PROCESS SKILL	NON-LINGUISTIC CUE	LINGUISTIC CUE
“Scientific Discourse”*	NA	Communicating about scientific discoveries or process
Hypothesizing	--	Making an “educated guess” about some phenomenon
Explaining	--	Drawing conclusions about some phenomenon on the basis of evidence
Predicting	--	Stating what is likely to occur (if an explicit or implicit hypothesis is true)
Revising hypotheses/ explanations	--	Revising conclusions about some phenomenon
Generalizing	--	Reaching a broader conclusion on the basis of some phenomenon

*The quotation marks indicate developmentally appropriate and foundational level of these categories of Science Process Skills.



November 24, 2004

Dr. Nancy Clark-Chiarelli
Education Development Center, Inc.
55 Chapel St.
Newton, MA 02458

On behalf of ABCD Boston, I am writing to express our willingness to participate in the pilot test of Foundations of Science Literacy. We are very excited about ensuring the success of this program and its extension into the Head Start curriculum.

For the past three years we have been a part of your Head Start Quality Improvement Center, participating in your literacy professional development program (PD-LIT). Over the last three years this literacy approach has been taught to our education staff at four of our Head Start Programs. Our staff has benefited from your approaches to providing in-depth, research-based professional development. We look forward to bringing your quality work in science to our program.

Once again we are committed to be the pilot program for this project. We will help you recruit ABCD education staff for the course, and we will support your research team throughout their pre-and post-data collection. We look forward to continuing the productive relationship we have with EDC.

Sincerely,

Sharon Scott-Chandler
Vice President, Head Start and Children's Services



Communities United, Inc.

***135 Beaver Street
Waltham, MA 02452***

(781) 736-7890

(781) 899-1859 fax

November 12, 2004

Dr. Nancy Clark-Chiarelli
Education Development Center, Inc.
55 Chapel St.
Newton, MA 02458-1060

Dear Nancy:

I am delighted to write this letter of commitment on behalf of Communities United, Inc. Head Start. We are very interested in participating in your study, which examines the impact of *Foundations of Science Literacy* on teacher development and children's science learning. We understand the important role science inquiry can have on all aspects of children's learning, and especially appreciate the focus on children who are learning English, a growing population in our program.

I therefore confirm our commitment to provide intervention and control classrooms, understanding that assignment will be random. To ensure that the needed data is collected from both our intervention and control classrooms, we will collaborate with the research team throughout the life of the project.

We look forward to participating in this research project and contributing to a better understanding of the role that science can play in children's early development.

Sincerely,

Stacy Dimino
Executive Director

Program Director: Clark-Chiarelli, Nancy

Application Number: R305MA5060



*Child Care &
Head Start Services*

A Division of Montachusett Opportunity Council, Inc.

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**Latino Services &
Community Linkages**

(978) 343-2760
Fax (978) 343-6238

November 10, 2004

Nancy Clark-Chiarelli
Education Development Center
55 Chapel Street
Newton, MA 02458

Dear Nancy:

I am pleased to write this letter of commitment for your proposal to study the impact of *Foundations of Science Literacy*, an early childhood science course. As a quality preschool Head Start and child care program in our region, we are constantly seeking professional development that improves the learning outcomes for the children in our care. We are especially interested in your focus on children who are learning English. They represent a growing number in our classrooms.

If the grant is funded, we will guarantee the participation of several teams in the *Foundations* course and participating teachers will adopt *The Young Scientist Curriculum*. We understand that we will also provide control classrooms. We look forward to collaborating with the research team as they collect data.

Our program has benefited from our past involvement in your Excellence in Teaching courses and we respect the work EDC has undertaken in conducting research and developing innovative curriculum to improve outcomes for children and families.

I look forward to coring with you on this important effort.

Yours truly,

Deborah Hubbard
Director



SMOC Head Start

300 Howard St. 3rd fl. • Framingham, MA 01702

Phone (508)820-4631 Toll Free 1-800-779-4853 FAX (508)879-1022

November 12, 2004

Dr. Nancy Clark-Chiarelli
Education Development Center, Inc.
55 Chapel St.
Newton, MA 02458-1060

Dear Nancy:

I am delighted to write this letter of commitment on behalf of SMOC Head Start. We are very interested in participating in your study, which examines the impact of *Foundations of Science Literacy* on teacher development and children's science learning. We see this as an opportunity to support the professional development of our teachers, and especially appreciate the focus on children who are learning English, a growing population in our program.

I therefore confirm our commitment to provide intervention and control classrooms, understanding that assignment will be random. To ensure that the needed data is collected from both our intervention and control classrooms, we will collaborate with the research team throughout the life of the project.

We look forward to participating in this research project and contributing to a better understanding of the role that science can play in children's early development.

Sincerely,

A handwritten signature in black ink, reading "Philip Fokas". The signature is fluid and cursive, with the first name "Philip" and last name "Fokas" clearly distinguishable.

Philip Fokas
Director

Program Director: Clark-Chiarelli, Nancy

Application Number: R305MA5060

Self Help, Inc. Head Start / Preschool Programs
The Community Action Agency of Greater Brockton & Attleboro
370 Howard Street, Brockton, MA 02302

Telephone #: 508-587-1716

FAX #: 508-587-1717

Chairperson, Board of Directors
Lorraine Simon

Executive Director
Jonathan R. Carlson

November 15, 2004

Dr. Nancy Clark-Chiarelli
Education Development Center, Inc.
55 Chapel St.
Newton, MA 02458-1060

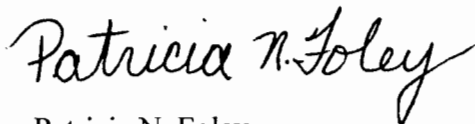
Dear Nancy:

On behalf of Self-Help, Inc. Head Start, I am writing to express our programs willingness to participate in your study, which examines the impact of the *Foundations of Science Literacy* course and mentoring program on teacher development and children's science learning. We understand the important connection between a science rich curriculum and children's cognitive and language development and are eager to bring the important work EDC has done in this area to our program.

I therefore confirm our commitment to provide the needed number of intervention and control classrooms, understanding that assignment will be random. To ensure that the needed data is collected from both our intervention and control classrooms, we will collaborate with the research team throughout the life of the project.

We look forward to participating in this research project. We have been looking for an opportunity to bring EDC's excellent work in the area of teacher development and research to our program. We also see this as an opportunity to contribute to improved learning for children across the nation.

Sincerely,



Patricia N. Foley
Head Start Director

Serving the communities of:

Abington, Attleboro, Avon, Bridgewater, Brockton, Dedham, East Bridgewater, Easton, Foxboro, Franklin, Holbrook, Mansfield, Middleboro, Norfolk, Norton, Norwood, Plainville, Randolph, Rockland, Sharon, Stoughton, West Bridgewater, Whitman and Wrentham

Program Director: Clark-Chiarelli, Nancy

Application Number: R305MA5060



UNIVERSITY OF MASSACHUSETTS
AMHERST

Graduate & Undergraduate
Program Office
123 Furcolo Hall
813 North Pleasant Street
Amherst, MA 01003-9308

SCHOOL OF EDUCATION

voice: 413.545.0236
fax: 413.545.6130

November 17, 2004

Ms. Ingrid Chalufour
Education Development Center
55 Chapel Street
Newton, MA 02458-1060

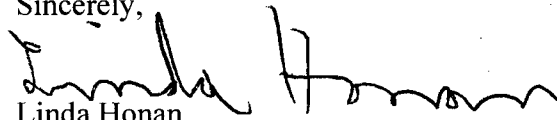
Dear Ingrid:

The University of Massachusetts Amherst School of Education is pleased to offer graduate and undergraduate credit for certain approved courses offered by the Education Development Center.

We are delighted to learn that you propose to offer science course(s) for educators. Upon this course, or these courses, and their instructor(s), receiving approval by the University of Massachusetts Amherst School of Education and Graduate School, we will be happy to offer credit for them through the Division of Continuing Education. The cost of this credit to participants is currently seventh-five dollars per credit, plus a registration fee of thirty-five dollars per semester or session. At this time, no increase is foreseen for the coming year.

We wish you and your colleagues every success in this valuable endeavor to improve science teaching in our schools.

Sincerely,


Linda Honan
Manager, K-12 Academic Outreach



10 Yorkton Court • St. Paul, Minnesota 55117-1065
Phone 651-641-0305 • 800-423-8309 Fax 800-641-0115



November 19, 2004

Dr. Nancy Clark-Chiarelli
Center for Children & Families
Education Development Center, Inc.
55 Chapel Street
Newton, MA 02458-1060

Dear Dr. Clark-Chiarelli:

Redleaf Press is delighted to support your proposal to examine the effectiveness of Foundations of Science Literacy on Head Start teachers' practice and children's learning. To that end, Redleaf will be happy to donate The Young Scientist Series Teacher's Guides needed for the pilot, control and intervention teachers in the first two years of the project. We will also provide trainers guides to the project mentors.

Redleaf Press is excited to be the publisher of The Young Scientist Teacher's Guides. We believe the materials are based on sound early childhood principles and they fill a resource gap in early childhood literature. We are delighted that National Association for the Education of Young Children will provide the Building Structures with Young Children Teacher Guide as a benefit to their 25,000+ comprehensive members in January 2005.

Again, I want to express our excitement about these materials and our eagerness to support Education Development Center in their ongoing work dedicated to early childhood education.

Sincerely,

Eileen M. Nelson
Director

Susan Carey

<susan.carey2@verizon.net>

11/29/2004 10:35 AM

To: Jess Gropen <JGropen@edc.org>

cc:

Subject: Re: serving as an advisor on an EDC proposal

Dr. Jess Gropen
Center for Children & Families
Education Development Center, Inc.
55 Chapel Street
Newton, MA 02458-1060

Dear Dr. Gropen:

I look forward to the opportunity to serve as an advisor to your Teacher Quality Research Grant, *Assessing the Potential Impact of a Professional Development Program in Science on Head Start Teachers and Children*. I understand that my commitment includes participation in an annual advisory board meeting and review of project documents related to my expertise.

As a cognitive scientist who has worked extensively in the areas of cognitive development and language acquisition in infants and preschool children, and on math and science education in elementary school aged children, I can offer insight into the relationship between science and language literacy, and how children's and teacher's naive theories can foster misconceptions in their understanding of the physical and life sciences. I also believe that this project addresses a great need, and proposes an intervention of great promise to the development of both teachers and children. I wish you the best in your effort to raise funds for this important endeavor.

Sincerely,

Susan Carey
Henry A. Morss Jr. and Elizabeth W. Morss Professor of Psychology, Harvard University
Professor, Harvard Department of Psychology

Program Director: Clark-Chiarelli, Nancy

Application Number: R305MA5060



Center for Cognitive Science (RuCCS)

152 Frelinghuysen Road ♦ Psych Bldg Addition ♦ Busch Campus ♦ Piscataway, New Jersey 08854

Rochel Gelman, Co-Director ♦ Center for Cognitive Science and Professor of Psychology
732) 445-6154 ♦ FAX (732) 445-6715 ♦ Email: rgelman@ruccs.rutgers.edu

November 22, 2004

Dr. Nancy Clark-Chiarelli
Center for Children & Families
Education Development Center, Inc.
55 Chapel Street
Newton, MA 02458-1060

Dear Dr. Clark-Chiarelli:

I look forward to serving on the advisory panel of your "Teacher Quality Research Grant, Assessing the Potential Impact of a Professional Development Program in Science on Head Start Teachers and Children". I understand that there will be three annual advisory board meetings, which will include a review of project documents expertise.

My work as a cognitive scientist whose work includes the area of preschool science education leads me to be very interested in EDC's effort to bring inquiry-based science curriculum to preschool classrooms especially Head Start. This project is extremely timely. The proposed intervention holds promise for impacting the development of both teachers and children.

I wish you the best in your effort to raise funds for this important endeavor.

Sincerely,

A handwritten signature in cursive script that reads "Rochel Gelman".

Rochel Gelman

Co-Director, Rutgers Center for Cognitive Science (RuCCS)
& Professor, Psychology



November 18, 2004

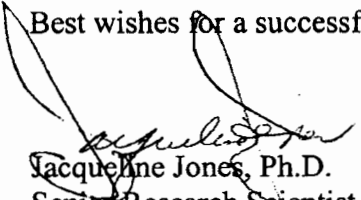
Dr. Nancy Clark-Chiarelli
Center for Children & Families
Education Development Center, Inc.
55 Chapel Street
Newton, MA 02458-1060

Dear Dr. Clark-Chiarelli:

I am delighted to accept your invitation to participate and contribute as an advisor to your Teacher Quality Research Grant, Assessing the Potential Impact of a Professional Development Program in Science on Head Start Teachers and Children. I understand that my commitment includes participation in three annual advisory board meetings and review of project documents related to my experience and expertise in early science learning.

Having worked with a variety of Head Start programs on documenting early science and literacy learning, I am particularly pleased to be part of this work. The project has the potential to address an important need in the field, and the proposed intervention holds great promise for providing a positive impact for both teachers and children. I wish you all the best and look forward to a productive working relationship.

Best wishes for a successful project,



Jacqueline Jones, Ph.D.
Senior Research Scientist
Director, Early Childhood Research & Development
Educational Testing Service
Rosedale Road - MS 07R
Princeton, NJ 08541
Phone: (609)-734-5167
Fax: (609)-734-1755

Program Director: Clark-Chiarelli, Nancy

Application Number: R305MA5060



UNIVERSITY OF MASSACHUSETTS
AMHERST

Tobin Hall
135 Hicks Way
Amherst, MA 01003-9271

Department of Psychology

voice: 413.545.2383
fax: 413.545.0996

November 29, 2004

Dr. Nancy Clark-Chiarelli
Center for Children & Families
Education Development Center
55 Chapel Street
Newton, MA 02458

Dear Nancy:

I am pleased to serve as a senior methodology advisor on your proposal, *Assessing the Potential Impact of a Professional Development Program in Science on Head Start Teachers and Children*. I look forward to contributing to annual advisory board meetings and reviewing critical issues related to the research design. As you know, I specialize in the application of statistical methods for multilevel data. Moreover, as a developmental psychologist I have a particular interest in the development of children at risk. I am pleased to work with you again and to bring my expertise in research design and quantitative methods to this important and innovative undertaking.

Sincerely,

A handwritten signature in cursive script that reads "Aline Sayer".

Aline Sayer, Ed. D.
Associate Professor of Psychology

Appendix B

Foundations: Sessions 3–8

Foundations Session 1: Sample Activity

FOUNDATIONS
CONTENT OF SESSIONS 3–8

Sessions 3–5: Moving Toward Inquiry-based Science Learning for Children will continue with the investigation of the properties of liquids, adding the concepts of buoyancy and density. Learning goals include to: 1) understand the concept of density (mass per unit volume); 2) be able to investigate and explain buoyancy and its relationship to the weight, density, and shape of an object *and* to the density and viscosity of a liquid; 3) learn how to conduct an open exploration of the properties of water with children; 4) learn how to conduct focused explorations of the properties of water; and 5) understand similarities and differences in adult and child inquiry-based investigations.

Sink and float activities at the water table are common in preschools, but many teachers unwittingly reinforce children's misconceptions about why objects sink and float. In fact, many adults ascribe the buoyancy of an object to a single characteristic such as weight. Thus, Session 3 will begin with explorations designed to surface teachers' theories and misconceptions. Then, using guided discussion techniques, participants will design investigations, in which groups test some of the predictions identified. In Sessions 4 & 5 instructors will further explore EDC's framework for science teaching, including using inquiry-based methods for teaching young children. Both sessions will build teachers' capacity to progress from open to focused explorations and use representation and content-rich conversations as a means of deepening conceptual learning. Instructors will use videotape exemplars and work samples to help teachers understand how science content and principles are instantiated differently when working with preschoolers. They will also discuss strategies to engage second language learners such as demonstration, modeling, and introduction of materials. The session will conclude by helping teachers prepare investigations at the water table for their own classrooms.

Sessions 6&7: Life Science Concepts and Pedagogy. In these sessions, teachers will be introduced to life science concepts and ways to investigate these concepts through examination of plants and small animals. Learning goals include to: 1) begin to understand key life science concepts, including awareness of the characteristics of living things (e.g., physical characteristics and the characteristics that define living organisms, basic needs of living things, the relationship between form and function, diversity and variation, relationship between an organism and its environment); 2) learn that studying life science in the immediate environment provides essential experience with many of the key life science concepts; 3) learn to facilitate focused exploration, including strategies for engaging English language learners in collaborative inquiry; and 4) support children's close observation of phenomena and use observational drawing for assessment purposes.

Session 6 will introduce teachers to the study of life science with an outdoor exploration. Instructors will ask participants to identify living and nonliving things, think about what defines life, and closely observe the characteristics of plants and animals they find. Guided discussions will highlight the diversity of participants' findings and focus on young children's explorations of the natural world. In Session 7, teachers will take part in an investigation of the characteristics of animals (e.g., earthworms or snails participants have found outside, meal worms that the instructor has brought). Teachers' understandings of science concepts and scientific inquiry will be used as a touchstone to discuss appropriate content and pedagogy with young children, using existing footage of Head Start teachers and children conducting a similar investigation of snails. Throughout, instructors will highlight specific strategies to engage children who are English

language learners in investigations—the use of visual displays (e.g., labeled diagrams and charts), grouping strategies that include children who exhibit different levels of proficiency in English, and the use of contextualized language. Also, teachers will plan how to use observational drawing as a way to assess children’s conceptual understanding.

Session 8: Long Term Investigations of Life Science. Teachers will continue to examine life science concepts and learn approaches to studying these concepts over time with young children. Learning goals include to: 1) continue to build an understanding of the main ideas in life science (e.g., characteristics of living things, relationship of form and function, basic needs and habitats, and the life cycle); 2) learn to build investigations around children’s interests and questions and extend inquiry over time; 3) learn strategies to engage children in literacy and math processes as they record and analyze data; and 4) practice strategies to engage children in conversations to deepen their science understandings, including strategies for English language learners.

Instructors will guide participants in examining data recorded on the growth of seedlings planted in the prior session. The parts of the plant will be discussed in terms of growth and development as well as form and function. Differences between kinds of organisms (i.e., animals and plants) will provide an opportunity to deepen teachers’ understanding of these concepts and stimulate discussion about basic needs and the life cycle. Teachers will prepare their data for analysis using mathematical concepts (e.g., measuring, graphing)—essential to scientific inquiry. Focus will then shift to how to apply the content and pedagogy with children, use of standard and non-standard units of measurement, and ways of graphing with young children. The session will end with instructors guiding teachers in the development of classroom plans for science investigation.

A FOCUSED EXPLORATION OF WATER FLOW

OVERALL GOAL: The activity follows participants' open exploration of water and provides an opportunity for teachers to use scientific inquiry to build an understanding of the properties of water related to flow while they experience the role of the teacher as a guide of inquiry.

OVERVIEW

- A. Facilitate a focused exploration of water flow (1.5 hours)
- B. Introduce the relevant science concepts and approach to inquiry (1.25 hours)

MATERIALS

- Sets of materials for groups of 3 or 4 to explore water (see resource section of Teacher's Guide for description of materials), such as
 - 1 large container (at least 10 inches wide x 15 inches long x 9 inches deep), about 1/2 to 2/3 filled with water. This can include one standard-sized water table.
 - 3 or 4 small, clear plastic containers of various shapes and sizes for pouring and containing water. They can include recycled plastic bottles, cups, measuring cups, etc.
 - 1 or 2 clear plastic pump bottles, such as those for liquid soap.
 - At least 3 pieces of clear flexible tubing of different diameters (1 piece of 1/4-inch inside diameter [i.d.], 1 piece of 3/8-inch i.d., 1 piece of 1/2-inch i.d.), cut to 1 1/2- to 2-foot lengths.
 - 1 or 2 turkey basters that can fit into at least one of the pieces of tubing.
 - 2 funnels that can fit into at least one of the pieces of tubing.
 - 1 kerosene or bilge pump.
 - 2 or 3 T- or Y-shaped connectors that can fit into at least one of the pieces of tubing.
 - 1 wire water wall (see resource section of Teacher's Guide for description): 1 piece of plastic-coated closet shelving (at least 15 inches wide) cut to fit inside a water table, and 2 smaller pieces of the shelving to act as end supports or "legs").

Note: For the first 15-minute portion of the exploration, have available all materials listed above except the T- and/or Y-shaped connectors and wire water wall.

- Newsprint Charts: What We Notice About Water; What We Notice About the Materials
- Camera and film (optional)
- Overhead projector, screen, and Overheads: Water Flow Concepts, Inquiry Diagram, and Discussion Questions

ACTIVITY

A. Facilitate a Focused Exploration of Water Flow (1.5 hours)

Purpose: By engaging participants in a water exploration you will:

- provide an experience with inquiry and the properties of water related to flow, including that it takes the shape of the container it is in; it flows; and it can be controlled in many ways.

*Foundations of Science Literacy Instructor Guide**Session I Sample Activity*

- reinforce the importance of firsthand experience in science learning
 - model the teacher's role as a facilitator of focused exploration and a guide in making meaning of experience
1. Introduce the exploration (5 minutes). Tell participants that they will spend some time exploring some of the materials and science concepts relating to water flow. Tell them that this activity will include time to experiment openly with the materials and some time when they will engage in specific investigations. Begin the exploration by showing teachers each of the materials.

Ask the teachers to form groups of three or four. Tell them to spend the next 15 minutes exploring flow with the materials, paying attention to the water itself. Keep group size as small as you can to increase engagement. Ask them to pay attention to your comments and questions and note how they influence their work and thinking.

2. Observe participants' explorations (15 minutes). Walk around the room and observe what teachers are doing. As they become engaged, encourage them to describe what they notice. Make comments or ask questions that encourage people to be descriptive, such as:
 - [When pouring water into a funnel attached to a clear tube] "Where is the water going?" "What happens when you lift the other end of the tube?" "Notice how the water behaves differently when the tube is in different positions."
 - [When squirting water into a clear tube with a baster] "How is the water flow different from when you poured it into the tube?"
3. Bring teachers together for a Science Talk (10 minutes). Ask the teachers to stop their exploration for a moment to discuss briefly what they've noticed about the materials and the water itself. Probe to get specific comments about their observations drawing out how water flow changes with different conditions. Highlight any discrepancies in observations, suggesting that they might want to revisit what they did and observe again. List people's observation on the charts, What We Notice About Water Flow and What We Notice About the Materials.
4. Facilitate an exploration of water flow with the wire water wall (40 minutes). Help the teams set up the wire water wall. Give them the T- and Y-shaped connectors and demonstrate how the connectors fit into the tubing so it is possible to have more than one stream of water flowing at a time. Demonstrate how the tubing can be passed through or attached to the water wall, freeing up their hands. Tell teachers that these materials are being added as a way for them to support the tubing and expand the possibilities for their water flow explorations. Ask them to use these materials to make water flow in as many ways as possible.

Note: You might want to take pictures that you can use later to demonstrate how teachers can use documentation to extend children's inquiry and learning.

As teachers return to their explorations, make sure each small group is using its time well. Connect the work of two groups if one needs jump-starting. Facilitate their experience by:

- encouraging them to try connecting the tubing together with the T- or Y-shaped connectors and noticing new ways they can control the flow of the water
- encouraging them to find different ways to move the water by changing the position of the tube in the wire wall and varying how they get the water into the tube
- helping them identify questions they want to investigate, such as, “How can they move the water through a horizontal tube?” Or, “How can they move water up?”
- asking them to document their work and findings by taking notes, making drawings, or writing down bits of conversation

Use probing questions to help teachers think about what they are doing and explore water more deeply. Focus the conversation on what the water does and how they use the materials to control water flow:

An example of a probing exchange:

Instructor (I): What were you doing with the tubing?

Teacher (T): I wanted to see what happened to the water when I raised one end.

I: And what happened?

T: The water level seemed to get lower in the end I raised, and then water started spilling out of the other end!

I: Did that surprise you?

T: Yeah.

I: What did you expect to see?

T: I guess I knew that the water would come out, but I didn't think it would come out so soon. I was so into the idea that the level got lower in the end I was raising, I totally forgot about the other end.

I: Why do you think the level seemed to get lower?

6. Facilitate another Science Talk (20 minutes). Bring the teachers together and ask for their new observations, adding them to the charts *What We Notice About Water* and *What We Notice About the Materials*. Draw out as many experiences and ideas as you can. As teachers share their findings you might want to have a few demonstrate what they were doing. Remember this conversation will continue as you make connections to the science concepts in the next conversation.

B. Introduce the Relevant Science Concepts and Approach to Inquiry (1.25 hours)

Purpose: Building an understanding of the science concepts is a central feature of *Foundations*, so these early connections between teachers' experience and the concepts are important. In addition, inquiry is a concept that is central to science and the approach to teaching they will be learning. In this activity, participants will gain a beginning understanding of inquiry by relating it to their focused exploration of water flow.

1. Introduce the relevant science concepts (10 minutes). Begin by explaining that your questions and comments during the teachers' exploration were partially designed to focus them on the science concepts. Show and review Overhead: Water Flow Concepts.

Overhead: Water Flow Concepts

- Water flows

Water's movement is generally described as flow. In most of the situations we encounter, water is flowing down due to gravity. This can be seen in many different ways—rivers flow from higher places to lower ones, drops of rain flow down window panes, streams of rain flow down gutters and downspouts, and water poured slowly from one cup to another will flow to the lower container.

- Water takes the shape of its container

When water is in a cup, pitcher, a tube, a bowl, a swimming pool, or a lake, wherever we encounter it, the surface of the water will be flat unless it is moved by something else (wind, shaking). All parts of the container will be filled with water.

- Water can be made to move in different directions

Using tubes or gutters, water can be made to flow to different places. One way water can be made to move up is to exert a force on it that is stronger than the downward pull of gravity, such as when you squirt it up out of a dropper or syringe.

- Water can be made to move faster or slower

The speed of water flow can be varied depending on the strength of the forces acting on it. A pump can make water move fast; water will go down a steep hill faster than a less steep one.

2. Relate the science concepts to teachers' exploration (20 minutes). Review the charts What We Notice About Water and What We Notice About Materials and ask participants to relate their observations to the science concepts. Encourage them to come up with examples of their exposure to these concepts. Probe for specific evidence and their conclusions.

Note: Encourage connections between their observations and the concepts such as: water moves down when poured; when a tube is filled with water it flows out of the lower end; if you hold a tube of water in a U shape, the levels of the water in each will be the same.

When energy is put into working a baster, pump bottle, or kerosene or bilge pump water can be made to move up. Encourage sharing of examples of ways they moved water from one container to another that demonstrate this.

Encourage comparison of the ways different materials move water. Draw out ways that they varied the speed and quantity of the flow.

3. Introduce the concept of inquiry (15 minutes). Tell participants that they have been engaged in the process of inquiry and that it is a central idea in science. Show Overhead: Inquiry Diagram and make specific references to their experiences with inquiry as you discuss what inquiry is. Be sure to make these points:
 - It is a dynamic process
This process is cyclical in nature. It cannot be fully represented in 2 dimensions.
 - It begins with engagement and wondering
Experience with the thing, materials, or event is the basis of inquiry. This initial exploration is a time for questioning, wondering, speculation, and “messing around”. At this point, you are likely to notice the characteristics of water, the materials, and what they will do.
 - Wondering leads to more focused observation and questions
As you explore, you may focus on a few specific questions that intrigue you. Why does the water not go into this small dropper? I wonder how the pump really works?
 - Questions focus observation and lead to investigation
In order to pursue something in depth, a single question needs to be identified and refined. There are many kinds of questions. At this point you consider which questions can be answered through simple investigations and/or which can be modified so they can be pursued through investigation. A good kind of question to pursue is a predicting question such as “What will happen if...”
 - Investigation is a cyclical process
Investigations begin with a focus or question like “How can I figure out how this pump works? What will happen when the water needs to get over the edge of the table into the bucket?” Investigation involves planning, observing closely, recording experiences, and reflecting in order to identify patterns and construct theories and explanations. In investigation, new questions arise and are pursued.
 - Share, discuss, reflect, draw conclusions
This is a time for making meaning of investigations. As a group, you and your colleagues share and form simple ideas and generalizations that will deepen your understanding of the concepts being explored.
4. Ask teachers to reflect on the role inquiry played in their exploration (30 minutes). Have them consider what aspects of the diagram describe experiences they had during the exploration. Ask them to talk in the teams in which they did their exploration. Review the guiding questions, showing Slide: Inquiry Discussion Questions, displaying the following questions:
 - How would you describe the inquiry you just engaged in? Are there particular aspects of the diagram that you experienced during your exploration? What are they?

*Foundations of Science Literacy Instructor Guide**Session I Sample Activity*

- What questions drove your investigation?
- What kind of data did you collect related to your questions and how did you document it?
- How did you use the data you collected?

After 10 minutes, bring them together and ask them to report. After all their ideas have been shared, probe for further analysis using these questions:

- Did identifying questions play a role in your exploration of water flow? What role did it play? Try to get examples of questions.
- Were you surprised by any of your evidence and how did that evidence influence changes in your thinking?
- When and how did you draw some conclusions?

Note: As you help teachers make connections between their investigations and the inquiry diagram, emphasize the following:

- Questions and focused activity grow out of open exploration and observation.
- Questions help focus observation and create the need for data collection.
- Sharing ideas exposes one to more data, different perspectives and ideas, and opens new doors for investigation.
- It is useful to record data as it is collected because it provides a reference for analysis.
- Science is grounded in evidence. An important part of inquiry is finding the evidence.

In conclusion, inform the teachers that they will be exploring the properties of water in smaller quantities. They will be deepening their understanding of the science and inquiry as you move along.